ISSN 0250-5193

GUJARAT AGRICULTURAL UNIVERSITIES RESEARCH JOURNAL

Agricultural University
Sardarkrushinagar

Anand Agricultural University
Anand

Junagadh Agricultural University
Junagadh

Navsari Agricultural University
Navsari

VOLUME : 40 NUMBER : 2

JULY, 2015

GAU RES. J. 40 (2)

PATRONS

Prof. (Dr.) Ashok A. Patel
Vice Chancellor
S.D. Agril. University
Sardarkrushinagar

Dr. N. C. Patel
Vice Chancellor
Anand Agril. University
Anand

Dr. A. R. Pathak
Vice Chancellor
Junagadh Agril.University
Junagadh

Dr. C. J. Dangari
Vice Chancellor
Navsari Agril.Univer
Navsari

ADVISORY BOARD

Dr. R. R. Shah, Director of Research & Dean PGS, S. D. Agril. University, Sardarkrushinagar

Dr. K. B. Kathiria, Director of Research & Dean PGS, Anand Agril. University, Anand

Dr. A. Y. Desai, Director of Research & Dean PGS, Junagadh Agril. University, Junagadh

Dr. A. N. Sabalpara, Director of Research & Dean PGS, Navsari Agril. University, Navsari

Dr. A. V. Barad, Dean, College of Agriculture, Junagadh Agril. University, Junagadh

Dr. M. K. Arvadia, Dean, N. M. College of Agriculture, Navsari Agril. University, Navsari

Dr. K. P. Patel, Dean, B. A. College of Agriculture, Ananad Agril. University, Anand

Dr. M. R. Prajapati, Dean, C. P. College of Agriculture, S. D. Agril. University, Sardarkrushinagar

Dr. J. B. Patel, Research Scientist, LRS, S. D. Agril. University, Sardarkrushinagar

Dr. D. C. Joshi, Dean, College of Food Processing Technology & BE, Anand Agril. University, Anand

Dr. M. K. Jhala, Associate Director of Research, Anand Agril. University, Anand

Dr. N. K. Gontia, Dean, College of Agril. Engineering & Tech., Junagadh Agril. University, Junagadh

Dr. L. R. Varma, Dean, College of Horticulture, S. D. Agril. University, Sardarkrushinagar

EDITORIAL BOARD

Dr. Y. Ravindrababu (Editor in Chief)

SDAU, Sardarkrushinagar

Dr. K. B. Prajapati, Research Scientist (LPM)
Dr. (Mrs.) Santosh Ahlawat, Professor (Ext. Edu.)
Dr. J. M. Patel, Assistant Research Scientist

AAU, Anand

Dr. D. M. Korat, Associate Director of Research (Agri.)
Dr. A. J. Dhami, Professor, (Vety. Gyanaecology & Obstetrics)
Dr. J. B. Prajapati, Professor & Head (Dairy Microbiology)

JAU, Junagadh

Dr. I. U. Dhruj, Associate Director of Research
Dr. H. B. Gardharia, Associate Educationalist
Dr. R. Subbaiah, Professor & Head (SWE), CAET

NAU, Navsari

Dr. S. R. Chaudhary, Associate Director of Research
Dr. B. N. Patel, Associate Director of Research
Dr. G. G. Radadiya, Professor(Entomology)

Vol. 40
Number 2
July 2015

Gujarat Agricultural Universities Research Journal

Contents

Research Papers

Official Publication of
Gujarat Agricultural Universities, Gujarat State

S.D.Agricultural University
Sardarkrushinagar

Anand Agricultural University
Anand

Junagadh Agricultural University
Junagadh

Navsari Agricultural University
Navsari

Our Esteemed Reviewers

Dr. Piyush Varma Associate professor Dept. of Horticulture, C. P. College of Agriculture S.D. Agricultural University Sardarkrushinagar - 385 506	Dr. Y. Ravindrababu Research Scientist, Centre of Excellence for Research on Pulses, S. D. Agricultural University Sardarkrushinagar - 385 506
Dr. M. V. Patel, Professor & Head, Dept. of Agronomy, B. A. College of Agriculture, Anand Agricultural University Anand – 388 110	Dr. V. H. Kanbi Associate Professor, Dept. of Biochemistry, Aspee College of Home Science & Nutrition, S. D. Agricultural University Sardarkrushinagar - 385 506
Dr. B. V. Padhiar Professor & Head, Dept. of Horticulture, N. M. College of Agriculture, Navsari Agricultural University, Navsari – 396 450	Dr. K. B. Prajapati Research Scientist, Livestock Research Station, S. D. Agricultural University, Sardarkrushinagar - 385 506
Dr. S. M. Upadhyay Professor & Head, Dept. of Agril. Statistics, College of Agriculture, Junagadh Agricultural University, Junagadh – 362 001	Dr. H. C. Patel Professor & Head, Dept. of Horticulture B. A. College of Agriculture, Anand Agricultural University Anand – 388 110
Dr. H. R. Pandya Professor & Head, Dept. of Agril. Statistics, N.M. College of Agriculture, Navsari Agricultural University, Navsari – 396 450	Dr. O. P. Khedar Professor, Pulse Breeding, Division of Plant Breeding & Genetics, Rajasthan Agricultural Research Institute, Durgapur - Jaipur : 302 018
Dr. G. N. Patel Research Scientist (Agronomy), Centre for Watershed Management, PR & RE S. D. Agricultural University Sardarkrushinagar - 385 506	Dr. A. J. Patel Programme Coordinator, Krushi Vigyan Kendra, S. D. Agricultural University, Deesa - 385 535

GAU Research Journal **40** (2) : 70-73 July 2015

Heterosis studies for grain yield and it's contributing traits in fieldpea [*Pisum sativum* (L.) var arvense.]

D. J. JOSHI[1], A.M.PATEL[2] AND Y. RAVINDRABABU[3]

Centre of Excellence for Research on Pulses,
S. D. Agricultural University, Sardarkrushinagar- 385 506 (Gujarat)

Received : 21 July, 2014

ABSTRACT

A field experiment was conducted to study the extent of heterosis in fifty five genotypes of fieldpea including ten parents and their forty five F_1's developed through half diallel mating design. Based on overall study of forty five hybrids for heterobeltiosis and economic heterosis the cross HUDP 954 x LFP 477 followed by HFP-4 x IPFD 10-13 and IPFD-1-10 x LFP 477 were found best heterotic combinations for yield and its contributing traits *viz.*, number of pods per plant, number of seeds per pod, number of primary branches, test weight and harvest index in fieldpea. These crosses could be exploited for isolating useful transgressive segregants in fieldpea.

Key words : Heterosis, heterobeltiosis, fieldpea

Fieldpea [*Pisum sativum* (L.) *var arvense*.] is an important *rabi* pulse crop grown in India. Two types of peas are generally cultivated, *i.e.*, one is the fieldpea (*Pisum sativum* (L.) *var arvense*) and other is gardenpea (*Pisum sativavum* (L.) *var hortens*). Fieldpea is generally used as a pulse crop and gardenpea as vegetable. Dry pea seed is valued primarily for the nutritional quality. Pea protein (19-27 %) is low in sulphur-containing amino acids, cysteine and methionine, but rich in lysine and other essential amino acids. Among the states, fieldpea is grown in Punjab, J & K, Himachal Pradesh, UP, Bihar, West Bengal, Assam, Rajasthan, Maharashtra and Madhya Pradesh. It is cultivated only as vegetable crop in north and middle parts of Gujarat. The scope for exploiting hybrid vigour in highly self- pollinated crops like fieldpea depends upon the direction and magnitude of heterosis. Present study was, thus, conducted to determine heterosis for yield and its contributing traits in fieldpea.

MATERIALS AND METHODS

The experimental material comprised of fifty five fieldpea genotypes including ten parents *viz.*, DF-1, HFP-4,HUDP 954, KPMR 400, HFP 715, Pant P 167, IPFD-1-10, LFP 477, IPFD 10-13, and GCO-703 and their forty five F_1's developed through half diallel mating design. The experimental material was grown in randomized block design with three replications with 45 cm x 10 cm row to row and plant to plant spacing, respectively during *rabi*, 2012 at Centre of Excellence for Research on Pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. All the management practices were followed as per recommendations to raise the normal crop. The observations were recorded on five randomly selected plants from each genotype in each replication for grain yield and its contributing characters *viz.*, number of pods per plant, number of seeds per pod, number of primary branches per plant, test weight and harvest index in Fieldpea. Different types of heterosis, i.e. heterosis over better parent (heterobeltiosis) and heterosis over standard parent (economic or standard heterosis) were estimated using mean values according to Fonseca and Petterson (1968) and Meredith and Bridge (1962), respectively.

RESULTS AND DISCUSSION

The details about range of heterosis, number of significant hybrids and best heterotic combinations for grain yield and its contributing traits are given in Table 1.

[1] Agril. Officer, Directorate of Research, [2]Assistant Research Scientist, [3] Research Scientist

Table 1 Heterobeltiosis, standard heterosis and best heterotic combinations for grain yield and its contributing traits in fieldpea.

Sr. No.	Traits	Range		No. of significant hybrids		Best heterotic combinations	
		Heterobeltiosis (BP)	Standard heterosis (SC)	Hetero-beltiosis (BP)	Standard heterosis (SC)	Heterobeltiosis (BP)	Standard heterosis (SC)
1.	Grain yield per plant (g)	-58.82 to130.82	-72.61 to 39.24	19	7	HUDP 954 x LFP477 Pant P 167 x GCO-703 HFP-4 x IPFD 10-13	IPFD-1-10 x LFP 477 HUDP 954 x Pant P 167 HFP-4 x Pant P 167
2.	Number of pods per plant	-48.96 to132.38	-63.54 to 27.08	13	1	HFP-4 x HFP715 IPFD-1-10 x IPFD 10-13 IPFD-1-10 x LFP477	HFP-4 x HFP 715
3.	Number of seeds per pod	-51.85 to35.29	-51.85 to 18.52	1	1	HFP-4 x LFP 477	HFP 715 x IPFD-1-10
4.	Number of primary branches	-22.33 to40.78	-36.89 to 46.78	4	4	IPFD 10-13 x GCO-703 IPFD-1-10 x LFP477 DF-1 x Pant P 167	IPFD 10-13 x GCO-703 IPFD-1- 10 x LFP 477 HFP-4 x IPFD-1-10
5.	Test weight (g)	-34.15 to28.93	-34.15 to 13.28	2	2	HUDP 954 x KPMR 400 HFP 715 x GCO-703	LFP 477 x GCO-703 HUDP 954 x KPMR 400
6.	Harvest Index (%)	-60.37 to113.05	-71.03 to 40.10	13	8	LFP477 x IPFD 10-13 HUDP 954 x GCO-703 DF-1 x IPFD-1-10	DF-1 x IPFD-1-10 LFP 477 x IPFD 10-13 DF-1 x HFP-4

For grain yield per plant wider range of heterobeltiosis (-58.82 to 130.82) and standard heterosis (-72.61 to 39.24) was recorded. Out of forty five hybrids nineteen and seven crosses were found significantly superior for better and standard parent heterosis, respectively. Based on the overall heterotic performance for grain yield per plant the cross HUDP 954 x LFP 477 followed by IPFD-1-10 x LFP 477 and HUDP 954 x Pant P 167 were adjudged as best combinations for heterobeltiosis. On the other hand for standard heterosis the cross IPFD-1-10 x LFP 477 and HUDP 954 x Pant P 167 were found best among all the hybrids. These findings are in close agreement with the report of Lejeune-Henaut *et al.* (1992), Punia *et al.* (2011) and Singh Manender *et al.* (2012).

In case of number of pods per plant a broad range of heterobeltiosis (-48.96 to 132.38) and standard heterosis (-63.54 to 27.08) was recorded. Out of forty five hybrids thirteen and one crosses were found significantly superior for better and standard parent heterosis, respectively. Based on the overall heterotic performance for number of pods per plant the cross HFP-4 x HFP 715 followed by IPFD-1-10 x IPFD 10-13and IPFD-1-10 x LFP 477 were adjudged as best combinations for heterobeltiosis. On the other hand for standard heterosis the cross HFP-4 x HFP 715 was found best among all the hybrids. These findings are in close agreement with the report of Karnwal and Kushwaha (2010), Punia *et al.* (2011) and Sharma and Lila Bora (2013).

Number of seeds per pod also depicted great range of heterobeltiosis (-51.85 to 35.29) and standard heterosis (-51.85 to 18.52). Out of forty five hybrids one cross was found significantly superior for better parent heterosis and none for standard parent heterosis. Based on the overall heterotic performance for number of seeds per pod the cross HFP-4 x LFP 477 was adjudged as best combinations for heterobeltiosis. On the other hand for standard heterosis the cross HFP 715 x IPFD-1-10 was found best among all the hybrids. These findings are in close agreement with the report of Borah (2009), Punia *et al.* (2011) and Kosev *et al.* (2012).

Number of primary branches showed good amount of range of heterobeltiosis (-22.33 to 40.78) and standard heterosis (-36.89 to 46.78). Out of forty five hybrids four and four crosses were found significantly superior for better and standard parent heterosis, respectively. Based on the overall heterotic performance for number of primary branches the cross IPFD 10-13 x GCO-703 followed by IPFD-1-10 x LFP 477 and DF-1 x Pant P 167 were adjudged as best combinations for heterobeltiosis. On the other hand for standard heterosis the cross IPFD 10-13 x GCO-703 followed by IPFD-1-10 x LFP 477 and HFP-4 x IPFD-1-10 were promising among all the hybrids. Similar findings were also reported by Lejeune-Henaut *et al.* (1992), Karnwal and Kushwaha (2010), Punia *et al.* (2011) and Sharma and Lila Bora (2013).

In case of test weight, higher range was observed for heterobeltiosis (-34.15 to 28.93) and standard (-34.15 to 13.28) heterosis. Among all the hybrids two and two crosses were found significantly superior for better and standard parent heterosis, respectively. The cross HUDP 954 x KPMR 400, and HFP 715 x GCO-703 showed best performances for heterobeltiosis. However, the cross LFP 477 x GCO-703 and HUDP 954 x KPMR 400 were also good for standard heterosis. Similar findings were also reported by Ercan Ceyhan *et al.* (2008) and Borah (2009).

For harvest index wide range of heterobeltiosis (-60.37 to 113.05) and standard heterosis (-71.03 to 40.10) was recorded. Out of forty five hybrids thirteen and eight crosses were found significantly superior for better and standard parent heterosis, respectively. Based on the overall heterotic performance for harvest index the cross LFP 477 x IPFD 10-13 followed by HUDP 954 x GCO-703 and DF-1 x IPFD-1-10 were adjudged as best combinations for heterobeltiosis. On the other hand for standard heterosis the cross DF-1 x IPFD-1-10 followed by LFP 477 x IPFD 10-13 and DF-1 x HFP-4 were found promising among all the hybrids. Such types of findings were also reported by Punia *et al.* (2011) and Singh Manender *et al.* (2012) for one or more aforesaid characters in fieldpea.

Based on overall study of forty five hybrids for better parent (heterobeltiosis) and standard parent heterosis (economic or standard heterosis) the cross HUDP 954 x LFP 477 followed by HFP-4 x IPFD 10-13 and IPFD-1-10 x LFP 477 were found best heterotic combinations for yield and its contributing traits *viz.*, number of pods per plant, number of seeds per pod, number of primary branches, test weight and harvest index in fieldpea. In present study for almost all the characters varying number of crosses depicted heterosis in both positive and negative directions indicating that, genes with negative and positive effects or a complementary type of gene interaction or simply correlated gene distribution may seriously inflate the mean degree of dominance and convert partial dominance in to apparent over dominance (Hayman, 1957). Since fieldpea is highly self-pollinated crop and in absence of economical methods of large scale grain production the exploitation of heterosis is

not possible. However, selection pressure can be applied in segregating generations to isolate pure lines having better performance.

REFERENCES

Borah, H. K. 2009. Studies on combining ability and heterosis in fieldpea (*Pisum sativum L.*). *Legume Research*, **32**(4) : 255-259.

Ercan Ceyhan, Mehmet Ali, Avci. and Serdar Karada. 2008. Line X tester analysis in pea (*Pisum sativum L.*). Identification of superior parents for seed yield and its components. *African Journal of Biology*, **7**(16) : 2810-2817.

Fonseca, S. and Patterson, F. L. 1968. Hybrid vigour in a seven parent diallel cross in common winter wheat (*Triticum aestivum L.*). *Crop Science*, **8** : 85-88.

Hayman, B. I. 1957. Interaction, heterosis and diallel crosses. *Genetics*, **42** : 336-355.

Karnwal, M. K. and Kushwaha, M. L. 2010. Studies on heterosis for pod yield and nitrogen fixing trait in gardenpea under dry temperate condition. *Legume Research*, **33**(1) : 50-53.

Kosev, V. Pachev, I. Angelova, S. and Mikic, A. 2012. Inheritance of quantitative traits in crosses between two (*Pisum sativum*) subspecies with particular reference to their breeding value. *Russian Journal of Genetics*, **48**(1) : 41-46.

Lejeune-Henaut. Fouilloux, G. Ambrose, M. J. and Etévé, V. G. 1992. Analysis of a 5-parent half diallel in dried pea (*Pisum sativum L*). I. Seed yield heterosis. *Agronomy*, **12** : 545-550.

Meredith, W.R. and Bridge, R.R. 1962. Heterosis and gene action in cotton. (*Gossypium hirsutum.). Crop Science*, **12** : 304-310.

Punia, S.S., Baldev Ram, Verma, P., Koli, N.R. and Rokaria, P. 2011. Combining Ability Studies in fieldpea *(pisum sativum L.). Journal of Food Legumes.*, **24**(3) : 120-124.

Sharma, Vinod K. and Lila Bora. 2013. Studies on genetic variability and heterosis in vegetable pea (*Pisum sativum L.*) under high hills condition of Uttarakhand, India. *African Journal of Agricltural Research*, **8**(18) : 1891-1895.

Singh, Manender, Malik, Sunil, Kumar Mukesh, Kumar Sanjiv, Dev Pavitra and Kumar Vinuj. 2012. Study of heterosis for seed yield and its contributing traits in fieldpea (*Pisum sativum L.*). *An International Journal of Plant Research*, **25**(1) :184-189.

GAU Research Journal **40** (2) : 74-77 July 2015

Effect of integrated nitrogen management on growth, yield and quality of greengram [*Vigna radiata* (L) Wilczek] in north Gujarat

LALITA H. SAINI[1], P. P. CHAUDHARI[2] AND A. K. SAINI[3]

Department of Agronomy, C.P. College of Agriculture,
S. D. Agricultural University, Sardarkrushinagar-385 506 (Gujarat)

Received : 18 November, 2014

ABSTRACT

A field experiment was conducted during summer season of 2013 at Sardarkrushinagar, Gujarat to find out effect of integrated nitrogen management on growth, yield and quality of greengram [*Vigna radiata* (L) Wilczek] in north Gujarat. The results showed that integrated application of recommended dose of nitrogen (20 kg N/ha) through organic and inorganic sources of nitrogen like, 25% RDN from FYM +75% RDN from urea significantly enhanced plant growth and growth attributes. Combined application of RDN as 25% RDN from FYM +75% RDN from urea recorded higher values for number of pods per plant (37.3), number of seeds per pod (10 seed/pod), 1000-seeds weight (40.8 g), seed yield (1632 kg/ha), stover yield (4375 kg/ha) and grain protein content (22.3%) over other combination and sole application of organic and inorganic sources of nitrogen.

Key words : Castor cake, economics, protein, greengram

Greengram is one of the most ancient and extensively grown pulse crops of India. The agronomical importance of greengram is linked to its high protein content and other essential minerals, especially micronutrients. The productivity of greengram in India is very low and far below the other greengram-growing countries. The adoption of modern farming practices and integrated nutrient management is essential to produce crops in line with the observed global standards of quantity and quality. Among the major plant nutrients, nitrogen is one of the most important major plant nutrients, which plays a vital role in plant metabolism, photosynthesis and plant growth processes. It is an integral part of chlorophyll, imparts green colour to leaves, constitutes about 1-4 % of the dry weight and an essential constituent of different type of metabolically active compounds like aminoacids and proteins. Studies conducted on grain legumes revealed that plant growth is affected differently by various N sources (Ryle *et al.*, 1978). There is no compromise on the need for the judicious use of N fertilizers for increasing greengram productivity despite the fact that the cost of N fertilizers increases year by year.

The high cost of chemical nitrogen fertilizer and low purchasing power of Indian farmers restricts its use on proper amounts, hampering crop production. Reliance on the increased use of chemical fertilizers and associated hazards put back attention on organic sources which are effective in promoting health and productivity of the soil. In addition to supply of nutrients, organic source improves the physical conditions and biological health of soil, which improves the availability of applied and native nutrients (Dick and Gregorich, 2004). With a view to reduce the losses and indiscriminate use of chemical fertilizers, substitution of part of the chemical fertilizer by locally available organic sources of nutrients, *viz.* manures, compost, green manures, crop residues, bio fertilizers etc. is inevitable. Farmyard manure (FYM) being the source of all essential elements, improves soil organic matter and humus part of soil. Castor cake (CC) is a plant originated natural nitrogen fertilizer, rich in nitrogen, phosphorus, potassium, trace elements and organic matter and helps to neutralize the detrimental effects of chemical fertilizers. But use of organics alone does not result

[1] Agril. Officer, Agricultural Research Station, Ladol, [2]Associate Professor, [3]Assistant Research Scientist, AICRP on IFS

in spectacular increase in crop yields due to their low nutrient content and also availability. Combined application of inorganic and organic sources of nutrients may be an important strategy for sustainable production of crops. This may not only improve the efficiency of chemical fertilizers along with their minimal use in crop production besides increasing crop yield and improving available major and minor nutrients (Rautaray *et al.*, 2003) Therefore, in the present context, a judicious combination of organic and inorganic fertilizers helps to maintain soil and crop productivity. The lack of information on these aspects under summer conditions made as impetus to undertake the present study.

MATERIALS AND METHODS

The experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during summer season of 2013. The soil of the experimental field was loamy sand and low in organic matter, low in organic carbon (0.17 %) and available nitrogen (159 kg/ha), medium in available phosphorus (31.20 kg/ha) and available potash (271 kg/ha) with 7.05 soil pH. Nine treatments comprising urea, FYM and castor cake application *viz.*, 100% RDN (20 kg N/ ha) from urea, 100% RDN from FYM), 75% RDN from FYM +25% RDN from urea, 50% RDN from FYM +50% RDN from urea, 25% RDN from FYM +75% RDN from urea, 100% RDN from CC, 75% RDN from CC +25% RDN from urea, 50% RDN from CC +50% RDN from urea and 25% RDN from CC +75% RDN from urea were tested in randomized block design with four replications. Nitrogen application was made as per the treatments in the form of urea, FYM and castor cake. Farmyard manure and castor cake were thoroughly incorporated in soil in furrow as per treatment allocation 22 days before sowing. The nitrogen from inorganic fertilizer (urea) as per treatment was applied at the time of sowing. Recommended dose of phosphorus @40 kg P_2O_5/ ha was supplemented through single super phosphate and applied at the time of sowing. All other cultural practices were performed uniformly for all treatments. Greengram variety Meha (IPM 99-125) was sown manually on 1st March, 2013 using recommended seed rate of 18 kg/ha and keeping 45 cm distance between two rows at the depth of about 4-5 cm. Weeding and plant protection measures were undertaken as per the need and the required plant population was maintained.

The observations were recorded during the course of study including plant height (cm), and dry matter accumulation (g) at 30, 60 DAS and at maturity, number of branches per plant, number of pods per plant, number of seeds per pod, 1000 seed weight (g), biological yield (kg ha^{-1}), seed yield (kg ha^{-1}), harvest index (%) and grain protein contents (%). The collected data for various parameters were statistically analyzed using Fishers' analysis of variance (ANOVA) technique and the treatments were compared at 5% level of significance.

RESULTS AND DISCUSSION

Conjunctive supply of Recommended dose of N through organic and inorganic sources *viz.*, 25% RDN from FYM +75% RDN from urea and 25% RDN from castor cake (CC) +75% RDN from urea remain statistically at par to each other, significantly increased the plant height and dry matter accumulation per plant at 30, 60 DAS and at harvest, number of branches per plant and number of root nodules per plant at peak flowering stage of green gram over other combination as well as sole application of organic and inorganic sources of nutrients (Table 1). Application of 25% RDN from FYM +75% RDN from urea registered maximum plant height (14.8, 50.2, 63.8 cm) and dry matter accumulation per plant (4.0, 16.7, 34.2 g) at 30 DAS, 60 DAS and at harvest respectively as well as branches per plant (6.5) and root nodules per plant(18.4). Application of 25% RDN either from FYM or castor cake with 75% RDN from urea gave 7.87, 3.72 per cent higher dry matter accumulation over 100% RDN from urea at harvest. Other combinations of organic and inorganic sources of nutrients *viz.*, 75% RDN as FYM +25% RDN as urea, 50% RDN as FYM +50% RDN as urea, 75% RDN as CC +25% RDN as urea, 50% RDN as CC +50% RDN as urea remained at par each other in increasing plant height and dry matter accumulation, while sole application of organics *viz.* 100% RDN as FYM and 100% RDN as CC had no significant effect on growth attributes. Application of inorganic with organic manure might have supplied the adequate and continuous amount of nutrients at different stages due to release of sufficient amount of nutrient by mineralization at a constant level that resulted in higher plant growth. The results are in conformity with those reported by Sharma *et al.* (2009).

Application of 25% RDN through FYM +75% through urea recorded higher values for number of pods per plant (37.3), number of seeds per pod (10 seed/pod), 1000-seeds weight (40.8 g), seed yield (1632 kg/ha),

Table 1 Effect of organic and inorganic sources of nitrogen on plant height, dry matter accumulation, number of branches/plant and number of root nodules of greengram plant at different periodical growth stages

Treatments	Plant height (cm)			Dry matter accumulation(g)			Number of branches/ plant	Number of root nodules/ plant
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At Harvest		
100% RDN as urea	16.2	46.9	61.8	4.2	16.7	31.7	5.3	15.6
100% RDN as FYM	11.8	41.7	52.8	2.9	11.4	27.2	4.7	15.8
75% RDN as FYM +25% RDN as urea	13.7	45.5	59.7	2.9	12.1	28.2	5.6	17.0
50% RDN as FYM +50% RDN as urea	14.2	47.8	61.5	3.4	16.6	32.7	6.4	18.4
25% RDN as FYM +75% RDN as urea	14.8	50.2	63.8	4.0	16.7	34.2	6.5	18.4
100% RDN as CC	11.4	40.7	50.7	2.5	10.6	26.7	4.0	15.1
75% RDN as CC +25% RDN as urea	13.4	44.3	56.3	2.7	11.7	27.4	5.0	16.4
50% RDN as CC +50% RDN as urea	13.3	47.6	58.7	3.0	14.5	31.8	5.8	17.3
25% RDN as CC +75% RDN as urea	14.5	49.9	61.8	3.7	15.7	32.9	5.7	17.5
SEM+	0.7	2.0	2.4	0.13	0.65	1.41	0.3	0.8
C.D.(P=0.05)	2.1	5.9	6.9	0.39	1.89	4.10	0.9	2.2

Table 2 Effect of organic and inorganic sources of nitrogen on yield and yield attributes of greengram plant

Treatments	Number of pods/ plant	Number of Seeds/ pod	1000 seeds weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Protein content in grain (%)	Cost of cultivation (₹/ha)	Cost of cultivation (₹ /ha)	B:C Ratio
100% RDN as urea	33.9	9.5	39.1	1451	4051	21.2	18135	62517	3.45
100% RDN as FYM	31.8	8.7	37.3	1215	3449	19.5	20303	47345	2.33
75% RDN as FYM +25% RDN as urea	34.3	9.5	39.6	1377	3634	20.7	19761	56357	2.85
50% RDN as FYM +50% RDN as urea	35.0	9.8	40.0	1516	3935	21.5	19219	64451	3.35
25% RDN as FYM +75% RDN as urea	37.3	10.0	40.8	1632	4375	22.3	18677	71673	3.84
100% RDN as CC	30.3	8.6	36.5	1157	3264	19.5	18850	45528	2.42
75% RDN as CC +25% RDN as urea	32.9	9.1	37.6	1361	3522	20.6	18675	56419	3.02
50% RDN as CC +50% RDN as urea	34.4	9.6	37.8	1481	3773	21.0	18500	63096	3.41
25% RDN as CC +75% RDN as urea	35.5	9.8	39.8	1528	4236	21.6	18310	66562	3.64
SEM+	1.3	0.3	0.87	77	218	0.56	446	2722	
C.D.(P=0.05)	3.7	0.97	2.54	224	635	1.64	1302	7946	

stover yield (4375 kg/ha) and grain protein content (22.3%). (Table 2) The per cent increase in seed and stover yield under of 25% RDN from FYM +75% RDN from urea was 12.47% and 7.99% over 100% RDN from urea. The increased availability of nitrogen under these treatments might have increased its uptake which enlarged cell size and enhanced cell division ultimately improved the photosynthesis and translocation of carbohydrates to sink site led to positive increase in yield attributes and yield, this finding confirms to those reported by Jat *et al.* (2012).

Maximum benefit : cost ratio (3.84) and net returns (₹ 71673/ha) were obtained with 25% RDN from FYM +75% RDN from urea application closely followed by 25% RDN from castor cake +75% RDN from urea. Application of 25% RDN either from FYM or castor cake with 75% RDN from urea gave 14.65, 6.47 per cent higher net return over 100% RDN from urea (Table 2). The results are in conformity with those reported by Jat *et al.* (2012).

In light of results obtained from present investigation, it is concluded that to achieve quantitative, qualitative and economical production of summer greengram (cv. Meha), crop should be fertilized with 25 % RDN (5 kg N/ha i.e. @ 0.69 ton FYM/ha) from FYM + 75 % RDN (15 kg N/ha) from urea in loamy sand soil.

REFERENCES

Dick, W. A. and Gregorich, E.G. 2004. Developing and maintaining soil organic matter levels. (In) *Managing soil quality Challenging Modern Agriculture*, pp.103-20.

Jat , A. R., Arvadia, M. K., Tandel, B., Patel, T.U. and Mehta, R.S. 2012. Response of saline water irrigated greengram (*Vigna radiate* L.) to land configuration, fertilizers and farmyard manure in Tapi command area of South Gujarat. *Indian Journal of Agronomy*, **57**(3): 270-274.

Rautaray, S., Ghosh, B.C. and Mittra, B.N. 2003. Effect of fresh, organic wastes and chemical fertilizers on yield, nutrient uptake, heavy metal content and residual fertility in a Rice–Mustard cropping sequence under acid lateritic soils. *Bioresource Technology*, **90**(3): 275-283.

Ryle, G. J. A., Powel, C. E. and Gordon, A. J. 1978. Effect of source of nitrogen on the growth of Fiskeby Soybean: The carbon economy of whole plants. *Annals of Botany*, **42**: 637-648.

Sharma, A., Kumar, A. and Potdar, M. P. 2009. Response of pigeonpea to conjunctive use of organic and inorganic source of fertilizers under rainfed conditions. *Karnataka Journal of Agricultural Sciences*, **22**(1): 8-10.

GAU Research Journal **40** (2) : 78-82 July 2015

Impact of different growth regulators, chemical and wax coating on quality of sapota fruits cv.'Kalipatti'

P. D. PATEL[1] AND A. D. PATEL[2]

Krishi Vigyan Kendra,
Anand Agricultural University, Arnej-382 230 (Gujarat)

Received : 18 November, 2014

ABSTRACT

Studies were conducted to assess the effects of different growth regulators, chemical and wax coating on quality parameters of sapota at ambient temperature. Sapota fruits were dipped in GA_3 @ 100, 200 ppm, NAA @100, 200 ppm and $AgNO_3$ @20, 40 ppm and then coated with wax 3 and 6 % under different treatments. Observations on various qualitative parameters were recorded at 6th, 9th, 12th and 15th days of storage period. Among different qualitative parameters, T.S.S., reducing sugar and total sugars of sapota fruits were increased and acidity was decreased with the increase in storage period at ambient conditions. The increase or decrease in various qualitative traits was faster in control treatment than treated fruits. Maximum T.S.S. and reducing sugars was recorded with GA_3 100 ppm and GA_3 200 ppm, throughout the storage periods, respectively. Significantly minimum acidity as 0.065, 0.038 and 0.021 % was recorded with GA_3 200 ppm on 9th, 12th and 15th days of storage periods, respectively. Maximum total sugar (17.77, 18.10 and 18.41 %) was recorded with $AgNO_3$ 40 ppm on 6th, 9th and 12th days of storage periods, respectively.

Key words : Growth regulator, sapota, wax coating

Sapota [(*Manilkara achras* (Mill.) Fosberg] is fifth popular fruit in both production and consumption next to mango, banana, citrus and grapes. In India, it is cultivated under area of 1.56 lakh ha. with a total production of 13.07 lakh M. T. (Anonymous, 2008-09). The major sapota growing states are Maharashtra, Gujarat, Tamilnadu, Andhra Pradesh, Karnataka, West Bengal, Utter Pradesh, Punjab and Haryana. Being climacteric in nature, the fruit needs ripening treatments after full maturity. Storage and ripening of sapota are beset with a number of problems under tropical conditions. Fruits ripen within 2 or 3 days and become overripe and spoiled within 5 days after harvest.

The short post-harvest life of horticultural crops is due to their perishable nature and physiological break down during handling, transport, storage and these losses are further enhanced by infection of post-harvest disease. The post-harvest management technology starts right from determination of proper harvesting stage, time and method of harvest, collection, sorting, grading, packaging and transportation, have an important role to play in minimizing the post-harvest loss. The technology aims to preserve quality, nutritional and economic value and assure food safety as well as regular supply of commodities for processing domestic markets and export.

[1] Subject Matter Specialist (Horti.), [2] Research Scientist, Medicinal and Aromatic Plant Research centre, Anand Agricultural Univrsity, Anand

MATERIALS AND METHODS

The experiment was conducted at Department of Horticulture, B.A.C.A., AAU, Anand during 2007-08 and 2008-09. The handpicked, firm and healthy sapota cv. 'Kalipatti' fruits of uniform size and maturity, free from pest and diseases, injuries, bruises and blemishes were plucked from Horticulture Research cum Demonstration Farm, AAU, Anand. Out of these fruits, two kg fruits were randomly selected and dipped in two growth regulators solution each at two levels *i.e.*, GA_3 100, 200 ppm, NAA 100, 200 ppm, a chemical at two levels *i.e.*, $AgNO_3$ 20, 40 ppm solution for ten minutes. Treated fruits then surface dried up to sufficient cool and coated with wax (58-60 °C) 3 and 6 % for a minute. The experiment was laid out in Randomized Block Design with factorial concept

comprising thirteen treatment combinations, *i.e.*, GA_3 100 ppm + Wax 3 %(T_1), GA_3 200 ppm + Wax 3 %(T_2), NAA 100 ppm + Wax 3 % (T_3), NAA 200 ppm + Wax 3 %(T_4), $AgNO_3$ 20 ppm + Wax 3 % (T_5), $AgNO_3$ 40 ppm + Wax 3 %(T_6),GA_3 100 ppm + Wax 6 %(T_7), GA_3 200 ppm + Wax 6 %(T_8), NAA 100 ppm + Wax 6 % (T_9), NAA 200 ppm + Wax 6 %(T_{10}), $AgNO_3$ 20 ppm + Wax 6 % (T_{11}), $AgNO_3$ 40 ppm + Wax 6 % (T_{12}) and control (T_{13}). The treated fruits then surface dried up to sufficient cool and then packed in card board cartoon of 30 x 30 x 30 cm size with 6 vents of 3 cm diameter, 3 each on opposite sides and stored in the laboratory at ambient temperature. The mean temperature and relative humidity prevailed during storage at both the season ranges from 25.7 to 31.2 °C, 39-72 % and 28.4 to 32.5 °C, 17-55 %, respectively. Observations on quality parameters viz.TSS, acidity, reducing sugars and total sugars were recorded. Acidity as citric acid was measured according to the method described by Ranganna (1979). Sugars were estimated by following the methods given by Lane and Eynon as described by Ranganna (1979). For recording all these parameters, five fruits were randomly selected from a single lot and replicated thrice. The data obtained were statistically analyzed.

RESULTS AND DISCUSSION

The data presented in Table 1 showed that various growth regulators and chemical significantly influenced T.S.S. of sapota fruits through out the storage period. During all the days of storage, maximum T.S.S. (22.00, 21.75, 22.50 and 22.75 %) was recorded with GA_3 100 ppm, respectively. Accumulation of T.S.S during process of ripening of fruits is a consequence of hydrolysis of polysaccharides. The accumulation of T.S.S. was lower and slower in case of untreated fruits than treated fruits, signifying the reduced rate of hydrolysis of starch due to gibberellin activity. The results are in conformity with the findings reported by Avaiya and Singh (1989) in sapota cv. 'Kalipatti', Gautam and Chundawat (1990) in sapota cv. 'Kalipatti', Balakrishnan (1998) in sapota cv. 'PKM-1', Madhavi and Srihari (2002) in sapota cv. 'Pala', Chahal and Bal (2004) in ber cv. 'Umran' and Rajkumar *et al.* (2005) in papaya cv. 'CO-2'. Higher content of T.S.S. in untreated fruits than NAA indicated faster rate of solubilization of the stored materials and hence the rise. The results are in conformity with the findings reported by Dhoot *et al.* (1984) in guava cv. 'Sardar' (L.49), Chahal and Bal (2004) in ber cv. 'Umran' and Gautam *et al.*(2003) in mango cv. 'Banganapalli'.

Table 1 Effects of different growth regulators, chemical and wax coating on T.S.S. of sapota cv.'Kalipatti' during different storage periods

Growth Regulators & Chemical(GC)	Total Soluble Solids (%)											
	6th day			9th day			12th day			15th day		
	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)
Control			20.50			21.50			22.50			24.00
GA_3 100 ppm	21.50	22.50	22.00	21.50	22.00	21.75	22.00	23.00	22.50	22.5	23.0	22.75
GA_3 200 ppm	20.50	21.50	21.00	20.50	21.00	20.75	21.00	21.50	21.25	21.5	22.0	21.75
NAA 100 ppm	20.50	20.50	20.25	20.00	20.50	20.25	20.00	20.50	20.50	21.0	21.5	21.25
NAA 200 ppm	21.00	20.50	20.75	21.00	20.50	20.75	21.50	21.50	21.50	22.0	21.5	21.75
$AgNO_3$ 20 ppm	18.50	18.50	18.50	19.00	18.50	18.75	19.50	19.50	19.50	20.5	19.5	20.00
$AgNO_3$ 40 ppm	17.00	17.50	17.25	17.00	18.00	17.50	18.00	18.50	18.25	18.5	18.5	18.50
Mean (W)	19.83	20.17	20.00	19.83	20.08	19.96	20.42	20.75	20.58	21.00	21.00	21.00
		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %
Growth Regulators & Chemical (GC)			2.74			2.21			2.75			3.39
Wax (W)			0.54			NS			NS			NS
Interaction (GC x W)			NS			NS			NS			NS

Table 2 Effects of different growth regulators, chemical and wax coating on acidity (%) of sapota cv.'Kalipatti' during different storage periods

Growth Regulators & Chemical (GC)	Acidity (%)											
	6th day			9th day			12th day			15th day		
	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)
Control			0.102			0.096			0.093			0.089
GA_3 100 ppm	0.139	0.122	0.130	0.064	0.075	0.069	0.040	0.042	0.042	0.022	0.028	0.025
GA_3 200 ppm	0.123	0.134	0.129	0.062	0.067	0.065	0.037	0.037	0.038	0.021	0.021	0.021
NAA 100 ppm	0.095	0.092	0.093	0.085	0.078	0.081	0.066	0.061	0.064	0.034	0.039	0.037
NAA 200 ppm	0.090	0.089	0.089	0.081	0.077	0.079	0.072	0.054	0.064	0.038	0.034	0.036
AgNO3 20 ppm	0.096	0.096	0.096	0.086	0.075	0.081	0.057	0.049	0.053	0.038	0.025	0.032
AgNO3 40 ppm	0.106	0.101	0.104	0.092	0.087	0.089	0.045	0.049	0.047	0.032	0.024	0.028
Mean(W)	0.108	0.105	0.107	0.078	0.077	0.077	0.053	0.046	0.051	0.031	0.029	0.030
		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %
Growth Regulators & Chemical (GC)			0.007			0.007			0.007			0.007
Wax (W)			NS			NS			NS			NS
Interaction (GC x W)			0.008			NS			NS			NS

Table 3 Effects of different growth regulators, chemical and wax coating on reducing sugars (%) of sapota cv.'Kalipatti' during different storage periods

Growth Regulators & Chemical (GC)	Reducing sugars (%)											
	6th day			9th day			12th day			15th day		
	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)
Control			12.55			14.68			16.66			19.39
GA_3 100 ppm	8.52	7.55	8.03	8.95	8.08	9.15	9.56	8.39	8.98	9.89	8.78	9.34
GA_3 200 ppm	8.53	7.72	8.12	8.85	8.19	9.30	9.31	8.61	8.96	9.85	9.38	9.62
NAA 100 ppm	7.60	7.67	7.64	7.70	7.56	7.40	7.73	7.61	7.67	7.77	7.68	7.73
NAA 200 ppm	7.70	8.00	7.85	7.76	8.06	7.95	7.87	8.10	7.99	7.89	8.17	8.03
AgNO3 20 ppm	8.36	8.43	8.40	8.56	8.54	8.63	8.70	8.64	8.68	8.86	8.41	8.64
AgNO3 40 ppm	8.26	8.34	8.30	8.44	8.25	8.49	8.58	8.46	8.52	8.75	8.33	8.54
Mean(W)	8.16	7.95	8.06	8.69	8.29	8.49	8.63	8.30	8.47	8.84	8.46	8.65
		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %
Growth Regulators & Chemical(GC)			NS			1.17			1.18			1.09
Wax (W)			NS			NS			NS			NS
Interaction (GC x W)			NS			NS			NS			NS

Table 4 Effects of different growth regulators, chemical and wax coating on total sugars(%) of sapota cv.'Kalipatti' during different storage periods

Growth Regulators & Chemical (GC)	Total sugars (%)											
	6th day			9th day			12th day			15th day		
	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)	Wax 3 %	Wax 6 %	Mean(GC)
Control			17.35			17.30			16.55			16.30
GA_3 100 ppm	17.10	16.90	17.00	17.76	16.40	17.08	18.36	17.75	18.05	19.75	19.60	19.68
GA_3 200 ppm	15.74	15.60	15.67	17.49	16.70	17.10	17.69	17.95	17.82	20.10	19.80	19.95
NAA 100 ppm	15.05	14.65	14.85	16.90	16.15	16.53	17.05	17.20	17.13	18.75	18.70	18.73
NAA 200 ppm	15.11	14.26	14.69	17.05	16.45	16.75	18.75	17.80	18.28	20.40	19.85	20.13
AgNO3 20 ppm	17.65	17.23	17.45	17.75	17.50	17.63	17.94	17.75	17.85	18.15	17.85	18.00
AgNO3 40 ppm	17.96	17.56	17.77	18.15	18.05	18.10	18.38	18.44	18.41	18.70	18.65	18.68
Mean(W)	16.44	16.04	16.24	17.52	16.88	17.20	18.03	17.82	17.92	19.31	19.08	19.19
		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %		F-test	CD at 5 %
Growth Regulators & Chemical (GC)			1.18			0.45			0.85			0.41
Wax (W)			NS			0.26			NS			0.24
Interaction (GC x W)			NS			NS			NS			NS

Various growth regulators and chemical significantly influenced acidity of fruits. (Table 2). During 9th, 12th and 15th days of storage, minimum acidity (0.065, 0.038 and 0.021 %) was recorded with GA_3 200 ppm respectively, which was followed by GA_3 100 ppm (0.069, 0.042 and 0.025 %), respectively. Acidity declined continuously during the entire storage period. This lower level of acidity in treated fruits compared to control may be attributed to its high utilization in the process of respiration during ripening in the process of reduced supply of sugar as a substrate of respiration due to slower rate of starch degradation and accumulation of these sugars during ripening due to various treatments. The results are in conformity with the findings reported by Gautam and Chundawat (1990) in sapota cv. 'Kalipatti', Sarkar *et al.* (1995) in sapota cv. 'Culcutta Round', Patil and Hulmani (1998) in banana, Damodaran *et al.* (2001) in sapota cv. 'Cricket Ball' and Jain *et al.* (2001) in mango cv. 'Langra'.

On 9th, 12th and 15th days of storage, various growth regulators and chemical significantly influenced reducing sugars of sapota fruits (Table 3). During 9th and 15th day of storage, maximum reducing sugars (9.30 and 9.62 %) was recorded with GA_3 200 ppm, respectively. While, on 12th day of storage maximum reducing sugars (8.98 %) was recorded with GA_3 100 ppm. The levels of reducing sugars accelerated throughout the period of ripening in sapota fruits. However, the pattern of acceleration varied with the different growth regulators tested, being comparatively slower in silver nitrate followed by NAA and GA_3 *vis a vis* control, where the increase was rapid and finally these untreated fruits showed the higher level of reducing sugars indicating early ripening compared to treated fruits. Accumulation of reducing sugars is a function of starch metabolism which is slower in treated fruits compared to untreated fruits. The results are in conformity with the results reported by Gautam and Chundawat (1990) in sapota cv. 'Kalipatti', Attri and Singh (1996) in sapota cv. 'Cricket Ball', Jain *et al.* (2001) in mango cv. 'Langra' and Gautam *et al.* (2003) in mango cv. 'Banganapalli'.

During all the days of storage, various growth regulators and chemical significantly influenced the total sugars of sapota fruits (Table 4). During 6th, 9th and 12th days of storage, maximum total sugar (17.77, 18.10 and 18.41 %) was recorded with $AgNO_3$ 40 ppm, respectively. Accumulation of total sugars during the process of ripening is a consequence of starch hydrolysis. In present study, accumulation of sugars was gradually increased in fruits treated with growth

regulators throughout the storage periods, being significantly the highest under the $AgNO_3$ @ 40 ppm treatment. It might be due to reduced rate of catabolic activities like respiration due to these treatments. The result of present investigation are in conformity with the findings reported by Gautam and Chundawat (1990) in sapota cv. 'Kalipatti'. In untreated fruits trend of accumulation of total sugars was reversed than that of growth regulators treated fruits. The final level of total sugars was also higher in treated fruits compared to control. Lower levels of sugars in untreated fruits might be due to high levels of starch hydrolysis. The present investigation is in conformity with the results reported by Gautam *et al.* (2003) in mango cv. 'Banganapalli' and Vijayalakshmi *et al.* (2004) in sapota cvs. 'CO-1' and 'CO-2'.

REFERENCES

Anonymous, 2008-09 Indian Horticultural Database-2008, National Horticulture Board, Director of Horticulture, Gujarat State, Gandhinagar.

Attri, B. L. and Singh, D. B. 1996. Effect of GA_3 and silver nitrate on the physicochemical characteristics of sapota cv. 'Cricket Ball' during storage. *Progressive Horticulture*, **28** (3&4): 137-142.

Avaiya, Y. V. and Singh, S. P. 1989. Studies on storage behaviour of sapota (*Achras sapota* L.) cultivars as influenced by ripening retardants. *Orissa Journal of Horticulture*, **17**(1& 2): 55-60.

Balakrishnan, K. 1998 *"Post-harvest Technology of Horticultural Crops"*. Group meeting of All India Co-ordinated Research Project held at, S.K.N. College of Agri., Rajasthan, Jan., 9-11, Vol.-1.

Chahal, S. and Bal, J. S. 2004. Quality of GA, NAA and wax treated *ber* (*Zizyphus mauritiana* LAMK.) fruits after storing them in cold storage for different durations. *Haryana Journal of Horticulure Science*, **33** (3&4): 240-242.

Damodaran, T. Attri, B. L. Medhi, R. P, Nair, S. A. and Alex, L. 2001. Studies on post-harvest management of sapota (Achras *zapota*) cv. 'Cricket Ball' during storage. *Indian Journal of Horticulture*, **58** (4): 342-345.

Dhoot, L. R. Desai, U. T. and Rane, D. A. 1984. Studies on the shelf-life of guava fruits with polythene packaging and chemical treatments. *Journal of Maharashtra Agricultural Univercity*, **9** (21): 185-188.

Gautam, B. Sarkar, S. K. and Reddy, Y. N. 2003. Effect of post-harvest treatments on shelf-life and quality of 'Banganapalli' mango. *Indian Journal of Horticulture*, **60** (2): 135-139.

Gautam, S. K. and Chundawat, B. S. 1990. Post-harvest changes in sapota cv. 'Kalipatti' : II-Effect of various post-harvest treatments on physico-chemical attributes. *Indian Journal of Horticulre*, **47** (3): 264-269.

Jain, S. K, Mukherjee, S. and Gupta, N. K. 2001. Effect of post-harvest treatments and storage condition on the quality of mango during storage. *Haryana Journal of Horticulture Science*, **30** (3&4):183-187.

Madhavi, M. and Srihari, D. 2002. Effect of post-harvest application of growth regulators on low temperature storage life of sapota [*Manilkara achras* (Mill.) Forsberg] fruits cv. 'Pala'. *South Indian Horticulture*, **50** (1&3): 185-189.

Patil, S. N. and Hulmani, N. C. 1998. Effect of post-harvest treatments on physical characters and shelf-life of banana fruits. *Karnataka Journal of Agriculture Science*, **11** (1): 134-138.

Rajkumar, M. Karuppaiah, P. and Kandasamy, R. 2005. Effect of calcium and gibberellic acid on post-harvest behaviour of papaya cv. 'CO-2'. *Indian Journal of Horticulture*, **62** (4): 327-331.

Ranganna, S. 1979. *Manual of analysis of fruit and vegetable products*. Tata McGraw Hill Publishing Company Ltd., New Delhi.

Sarkar, H. N. Hasan, M. A. and Chattopadhyay, P. K. 1995. Effect of packing and chemicals on the storage behaviour of sapota. *Horticulture Journal*, **8** (1): 17-24.

Vijayalakshmi, D. Bangarusamy, U. and Vijayakumar, R. M. 2004. Post-harvest treatments to extend the shelf-life of sapota fruit cultivars 'CO-1' and 'CO-2'. *Crop Research*, **27** (2&3): 219-226.

GAU Research Journal **40** (2) : 83-85 July 2015

Effect of spray treatment of plant growth substances at different stages on quality of sweet pepper (*Capsicum annum* L.) cv. Indra under green house

VANDANA PRAJAPATI[1] AND L. R. VARMA[2]

Department of Vegetable Science, College of Horticulture,
S. D. Agriculture University, Sardarkrushinagar-385 506 (Gujarat)

Received : 14 March, 2013

ABSTRACT

Among different spray treatment of plant growth substances on quality parameters like spray treatment of GA_3 50 mg/l was superior on ascorbic acid content of fruit (114.97 mg/100gm). The spray of NAA 20 mg/l was superior on diameter of fruit (5.39 cm) whereas the maximum length of fruit (7.99 cm) was found significantly with spray treatment of GA_3 25 mg/l. The maximum number of seeds/fruit was obtained with Control.

Key words : Sweet paper, green house, spray treatment

The genus *capsicum* belongs to the family solanaceae which is grown in several parts of the world. Sweet pepper is believed to be originated in Tropical South America with the seeds of a wild variety dating back to 5000BC (Shoemaker and Teskey, 1995). Sweet pepper (*Capsicum annum* L.) also known as 'shimla mirch' or 'bell pepper' or 'capsicum' is an important solanaceous vegetable. The hormonal use in the plant system and their importance is the outstanding discovery and achievement of plant sciences. Plant growth substances can be used at any stage of plant life. The method adopted successfully have been seed treatment, seedling treatment before transplanting as spray or mixed with irrigation water, cluster spray, injection etc. Moore (1950) found whole plant spray to be the most effective method of plant growth substances application to vegetables.

MATERIALS AND METHODS

The experiment was carried out during the year 2011-12 at Naturally Ventilated Greenhouse, Department of vegetable science, College of Horticulture, S. D. Agricultural University, Sardarkrushinagar. The experiment was laid out in Completely Randomized Design with Factorial concept. There were sixteen (16) treatment combinations comprised eight levels of plant growth substances viz. P_0 (Control), P_1 (Water spray), P_2 (GA_3 25 mg/l), P_3 (GA_3 50 mg/l), P_4 (NAA 20 mg/l), P_5 (NAA 40 mg/l), P_6 (Ethrel 50 mg/l), P_7 (Ethrel 100 mg/l) and two stages of spray viz. S_1 (spray at 20 days after seedling stage) andS_2 (spray at 20 days after transplanting). A number of observation *viz.*, diameter of fruit (cm), ascorbic acid (Vitamin-C) (mg /100 g of edible portion), length of fruit (cm) and number of seeds per fruit were recorded. The chemical analysis for estimating of ascorbic acid content in capsicum fruit (Rangana, 1977).

RESULTS AND DISCUSSION

Effect on quality parameters

The effect of different plant growth substances was found significantly for quality parameter. Treatment NAA 20 mg/l was produced maximum diameter of fruit (5.39 cm), while the minimum diameter was found in control. The probable reason for the maximum diameter of fruits due to the cell division and cell enlargement in the fruits after application of NAA. Similar finding have been also reported by Patel (1988) in okra and Patel (1993) in tomato.

The maximum ascorbic acid (114.97 mg/100g) was obtained in GA_3-50 mg/l treatment whereas; the minimum ascorbic acid content was obtained in water spray treatment. These finding are in close agreement with the results of Das and Prusty (1969), Irulappan

[1] P.G. Student, [2] Dean, College of Horticulture

Table 1 Effect of spray treatment of plant growth substances at different stages on diameter of fruit (cm) and ascorbic acid (Vitamin-C) (mg /100 g of edible portion)

Treatments	Diameter of fruit (cm)	Ascorbic acid (mg /100 g of edible portion)
Plant growth substances(P)		
P_0 - Control (No spray)	4.57	50.10
P_1 - Water spray	4.53	46.95
P_2 - GA_3-25 mg/l	5.30	94.86
P_3 - GA_3-50 mg/l	5.21	114.97
P_4 - NAA-20 mg/l	5.39	61.25
P_5 - NAA-40 mg/l	5.29	96.93
P_6 - Ethrel-50 mg/l	5.17	62.81
P_7 - Ethrel-100 mg/l	4.91	57.32
S.Em. ±	0.21	5.41
C.D. at 5%	0.61	15.59
Stages of spray(S)		
S1- At Seedling stage (20 day after seed sowing)	5.01	73.47
S2-After transplanting (20 day after transplanting)	5.08	72.83
S.Em. ±	0.11	2.71
C.D. at 5%	NS	NS
Interaction (P X S)		
S.Em. ±	0.30	7.65
C.D. at 5%	NS	NS
C.V.%	10.31	18.12

Table 2 Effect of spray treatment of plant growth substances at different stages on length of fruit (cm)

Treatments	Length of fruit (cm)	Number of seeds / fruit
Plant growth substances(P)		
P_0 - Control (No spray)	6.75	120.61
P_1 - Water spray	7.17	102.28
P_2 - GA_3-25 mg/l	8.10	58.05
P_3 - GA_3-50 mg/l	7.97	91.83
P_4 - NAA-20 mg/l	7.38	56.00
P_5 - NAA-40 mg/l	6.75	69.44
P_6 - Ethrel-50 mg/l	7.52	76.55
P_7 - Ethrel-100 mg/l	7.32	95.08
S.Em. ±	0.20	11.06
C.D. at 5%	0.56	31.87
Stages of spray(S)		
S1- At Seedling stage (20 day after seed sowing)	7.32	73.98
S2-After transplanting (20 day after transplanting)	7.39	93.48
S.Em. ±	0.10	5.53
C.D. at 5%	NS	15.94
Interaction (P X S)		
S.Em. ±	0.27	15.64
C.D. at 5%	NS	NS
C.V.%	6.42	32.35

and Muthukrishan (1969) and Sasikumar (1986) in tomato. The data revealed that the maximum length of fruit (7.99 cm) was recorded in GA_3 treatment whereas minimum length of fruit (6.75 cm) was obtained in control. This might be due to possible reason may be cell elongation and cell multiplication in fruits. Similar finding in close agreement with Patel (1988) in okra, and Patel (1993) in tomato.

REFERENCES

Das, R. C. and Prusty, S. S. 1969. A study on the effect of growth regulators on brinjal (*Solanum melongena* L.) *South India Horticulture*,**17** (3 & 4): 91-91.

Irulappan, I. and Muthukrishnan, C.R. 1973. Effect of growth regulators on growth and yield of tomato (*Lycopersicon esculantum* Mill.) *Madras Agriculture Journal*, **60** (9-12): 1644-1649.

Moore, R. H., 1950. Several effect of MH on plant. *Plant. Science*. **112:** 52-53.

Patel, J. S. 1993. Effect of plant growth regulators on growth, yield and quality of tomato (*Lycopersicon esculantum* Mill.) Cv. Marathan and brinjal (*Solanum melongena* L.) Cv. Surati Ravaiya. M.Sc.(Agri.) Thesis, GAU, Sardarkrushinagar

Patel, K. M. 1988. Efficiency of growth regulators and urea on growth, yield and yield components in okra (*Abelmoschus esculentus* L.). Cv. Pusa sawani. M.Sc. (Agri.) Thesis, GAU, Sardarkrushinagar

Rangana, S. 1977. Manual for analysis of fruit and vegetable products. Tata McGraw Hill. Co. Pvt. Ltd, New Delhi, pp-94-98.

Sasikumar, M. 1986. Studies on certain aspects of quality in tomato. M.Sc. (Agri). Thesis, TNAU, Coimbatore.

Shoemaker, J. S. and Tesky, B.J.E. 1995. Practical Horticulture. *John wiley and Sens. Inc.*, New York.

GAU Research Journal **40** (2) : 86-91 July 2015

Study of seed and oil quality characteristics of some castor (*Ricinus communis* L.) hybrids

S. K. SHAH[1], D. K. PATEL[2] AND P. S. PATEL[3]

Main Castor-Mustard Research Station,
S.D. Agricultural University, Sardarkrushinagar, 385 506 (Gujarat)

Received : 01 July, 2014

ABSTRACT

Castor is an important non-edible oilseed crop with diversified usage. India is dominating in the production and productivity of castor. Seventeen castor hybrids were studied for seed and oil quality as well as fatty acid profile by standard methods. The seed quality parameters of castor hybrids are the most important traits, which determine the price at the time of sale. Among the hybrids studied, the test weight was varied from 25.3 to 32.9 g. The seed oil content was found maximum (51.6 %) in SHB-875 and minimum (49.5 %) in GCH-5. The value of specific gravity varied from 0.934 to 0.958 while value of refractive index varied from 1.462 to 1.480. In the present study, specific gravity had a highly significant positive correlation with refractive index (r=0.932**). The viscosity of castor oil was in the range of 602 to 627 centipoise. The viscosity had a positive correlation with specific gravity (r=0.552*) and with refractive index (r=0.577*). The saturated fatty acids like palmitic and stearic acids were in range of 1.34 to 1.51% and 1.26 to 1.75%, respectively. Stearic acid had significant positive correlations with the FFA as oleic acid. The oleic acid ranged from 4.37% (PCH-248) to 10.54 % (SHB-918). The poly unsaturated fatty acids like linoleic and linolenic acid were in the range of 4.31 % to 4.86 % and 0.99 % to 3.00 %, respectively. Ricinolic acid, the predominant mono unsaturated fatty acid, varied from 81.21% (RHC-277) to 87.79% (SHB-875). The ricinolic acid content was significantly negatively correlated with oleic acid (r=-0.782**); and palmitic acid (r=-0.497*).

Key words : Castor hybrids, viscosity, ricinolic acid, fatty acid, castor oil quality

Castor oil, pale amber viscous liquid, derived from the seeds of castor. Castor oil is non-edible but very important industrial material which is characterized by its high viscosity, specific gravity and acetyl value. Castor (*Ricinus communis* L) grows naturally over a wide range of geographical regions. It is now cultivated in tropical as well as sub-tropical regions of the world. India has emerged as leader in production and productivity of castor in the world. The latest statistics shows that worldwide castor was grown on a total area of 1.68 m ha. Out of total global castor production, India produced 2.34 million tonnes of castor, while second and third largest producer countries, China and Brazil produced 0.18 and 0.12 million tones of castor, respectively (FAO, 2013). Ricinolic acid (12-hydroxy-9-octadecenoic acid) is the main component of castor oil, which occurs upto the extent of 85-95 % of the total fatty acid and is responsible for the peculiar characteristic of castor oil. Ricinolic acid allows castor oil suitable for trans-esterification to biodiesel (Shah, *et al*, 2013). The ester linkages, double bonds and hydroxyl groups in castor oil provide site for many chemical reactions and modifications and thus for preparation of valuable derivatives. Castor oil is an important reactant for interpenetrating polymer networks (IPNs) because, it contains hydroxyl groups capable of reacting with isocyanate and carboxyl groups.

The industrially important physicochemical properties of castor oil are due to combination of fatty acids, triacyl glycerol and oil content that varies from varieties and some other factors, such as climatic conditions and soil type. The fatty acids, being biological in origin, the composition is affected by the edaphological characteristics (Abolfazl *et al.*, 2011).

[1] & [2] Assistant Research Scientist, [3] Ex Research Scientist

Looking to the importance of the hybrids, castor hybrids were studied for seed physical characteristics, oil quality characteristics and fatty acid composition. At present the demand of castor hybrids with better yield with high oil content and high ricinolic acid content is increasing day-by-day. Therefore, it is necessary to develop and release such hybrids for industrial demands of the world.

MATERIALS AND METHODS

Seventeen castor hybrids were grown in Randomised Block Design with three replications during *Kharif* 2012-13 in Entisols of Main Castor-Mustard Research Station, S.D.A.U., Sardarkrushinagar (Gujarat, India). Recommended agronomic practices were followed to raise a healthy crop. The soil characteristics of experimental field were pH (1:2.5): 7.7, Avail. N (kg/ha): 192; Avail. P_2O_5 (kg/ha): 49; Avail. K_2O (kg/ha): 283. Castor seeds were harvested at physiological maturity and analysed for seed physical properties *viz.* 100 seed weight (g), seed oil content (%), kernel oil content (%), kernel (%), seed coat (%). Castor seed oil was extracted as per method prescribed in AOCS (Aa 4-38) by soxlet apparatus (AOCS, 1951). The oil quality parameters like viscosity was determined on viscometer (A&N Vibro Viscometer, Model SV 10) and the colour value was determined by Levibond tintometer with one inch cell. The other oil quality parameters like specific gravity and refractive index were determined as per standard methods. The fatty acid profile was determined on FTNIR (Bruker Optics-IFS MPA System) as per standard methods. All this physical parameters of seed, oil quality as well as the fatty acid profile under study are very useful for industrial purposes. Correlation coefficient was worked out for various characters under study.

RESULTS AND DISCUSSION

Seed quality parameters

Seed quality parameters of castor hybrids are the most important traits, which determine the price at the time of sale. Data of seed quality parameters of castor hybrids studied were presented in Table 1. Maximum value of 100 seed wt. 32.9 g was determined in SHB-981 hybrid and the lowest value of 25.3 g was observed in PCH-254 hybrid. Seed weight is considered as the most important characteristics for oil extraction. The seed oil content was determined in maximum 51.6 % in SHB-875 and the lowest value 49.5 % in GCH-5. The study reveals that there was not much wider difference in seed oil content among hybrids under study, the difference of the oil content was 2.1 %. The variation in oil content might be due to genotypic variability. The better oil yield makes the industrial practice of oil recovery a profitable venture. The values of oil content resembled with the findings of Lavanya *et al.* (2012). The kernel oil content was determined in maximum (63.3 %) in PCH-254 hybrid and the lowest value (61.5 %) was observed in DSH-519. The highest value of kernel % was determined in DSH-519 (72.9) and the lowest value of 69.4 % was observed in SHB-871. The lower value of seed coat % is desirable character for better oil recovery (Moskin, 1986).

Oil quality parameters

Among the castor hybrids studied, specific gravity varied from 0.934 to 0.958. The values of specific gravity were in line with the findings Abitogun *et al.* (2009). The value of refractive index, an indication of the level of saturation of the oil, varied from 1.462 to 1.480. In the present study, specific gravity had a highly significant positive correlation with refractive index (r=0.932**). The variation in the values might be attributed to the differences in genotypes (Akpan *et al.*, 2006). The viscosity of castor oil was in the range of 602 to 627 centipoise. The correlation coefficients between different quality parameters are presented in Table 3. In the present study, the viscosity had a positive correlation with specific gravity (r = 0.552*) and with refractive index (r = 0.577*). The hydroxyl group of ricinolic acid imparts a very high degree of viscosity and oxidative stability, which was four times more stable than the olive oil. The hydroxy group of recinolic acid imparts a very high degree of viscosity and oxidative stability (Patel *et al.*, 2004). The castor oil is mainly used as a lubricant because of its property to remain liquid at very low temperatures (-32°C), high density and viscosity (Nagraj, 1995). The colour of crude castor oil was yellow to brown and the value was in the range of 0.3 to 1.0. The variation in oil colour is attributed to colour of seed hull. For different industrial utilization, colourless oil is preferred. Industry could take benefit of the natural colour value of the oil for different uses. The high value was as a result of the presence of high number of red pigment.

Fatty acid profile

The quality of oil is a function of its fatty acid composition, depending on the fatty acid distribution, there was specific physical and chemical properties (Table 2). One of the most dominant parameter

Table 1 Determination of seed quality characteristics of castor hybrids

Castor Hybrid	100 Seed wt. (gm)	Seed oil content (%)	Kernel oil content (%)	Kernel (%)	Seed coat (%)	Specific gravity (g/Cc) at 25 C	Refractive Index (nd) at 25 C	Viscosity (cp) at 25 C	Colour value (Y+R)
JHB-977	30.4	51.4	62.3	72.5	27.5	0.957	1.478	618	0.3+2.0
SHB-918	27.9	50.9	63.2	70.1	29.9	0.958	1.480	627	0.7+1.0
PCH-254	25.3	51.3	63.3	69.9	30.1	0.957	1.479	627	0.4+2.0
SHB-890	32.1	50.5	63.0	69.5	30.5	0.957	1.478	605	0.2+1.0
SHB-891	26.1	51.2	62.6	70.0	30.0	0.957	1.478	607	0.3+2.0
JHB-981	32.9	50.8	62.9	70.3	29.7	0.957	1.477	605	0.6+1.0
JHB-985	31.9	51.4	63.1	70.3	29.7	0.957	1.479	620	1.0+0.8
PCH-248	27.4	50.9	63.2	70.9	29.1	0.943	1.462	610	0.9+2.0
SHB-871	31.4	51.0	62.7	69.4	30.6	0.953	1.475	615	0.9+1.0
SHB-874	27.9	51.5	62.5	69.7	30.3	0.955	1.475	625	1.0+0.6
SHB-875	30.6	51.6	62.9	72.3	27.7	0.939	1.465	603	0.8+1.0
SHB-872	31.7	51.0	62.7	71.9	28.1	0.949	1.469	610	0.3+1.0
RHC-277	31.0	51.4	62.5	70.5	29.5	0.934	1.467	609	0.5+2.0
DCH-177	30.1	50.7	62.5	69.5	30.5	0.937	1.466	608	0.5+1.1
DCH-519	26.7	49.3	61.5	72.9	27.1	0.956	1.478	613	0.3+1.0
GCH-5	28.2	49.5	62.7	72.1	27.9	0.939	1.463	602	0.8+1.0
GCH-7	31.0	51.1	62.2	69.9	30.1	0.936	1.463	608	1.0+0.5
Mean	29.6	50.9	62.7	70.7	29.3	0.949	1.472	613	
SEM±	0.6	0.2	0.1	0.3	0.3	0.002	0.002	2.0	
SD	2.3	0.6	0.4	1.2	1.2	0.009	0.007	8.2	

Table 2 Fatty acid composition of castor hybrids

Castor Hybrid	% free fatty acid as Oleic acid	Fatty acid composition (%)					
		C16:0 Palmitic	C18:0 Stearic	C18:1 Oleic	C18:2 Linoleic	C18:3 Linolenic	C18:1 (OH) Ricinoleic
JHB-977	1.09	1.34	1.28	5.14	4.74	0.99	85.64
SHB-918	2.93	1.40	1.26	10.54	4.79	1.09	81.51
PCH-254	1.18	1.41	1.28	6.02	4.81	1.07	83.85
SHB-890	2.11	1.43	1.27	6.38	4.78	1.14	84.31
SHB-891	1.17	1.42	1.28	6.44	4.86	1.15	84.03
JHB-981	2.28	1.41	1.30	6.00	4.79	1.13	84.21
JHB-985	1.26	1.42	1.29	5.74	4.75	1.09	84.19
PCH-248	3.05	1.38	1.45	4.37	4.62	1.63	87.68
SHB-871	1.24	1.50	1.36	6.67	4.63	1.41	82.82
SHB-874	1.87	1.36	1.32	6.39	4.69	1.18	84.88
SHB-875	1.89	1.37	1.50	4.45	4.61	1.85	87.79
SHB-872	1.36	1.43	1.37	4.86	4.72	1.41	87.16
RHC-277	2.87	1.43	1.57	7.97	4.57	2.29	81.21
DCH-177	2.84	1.41	1.71	5.02	4.62	2.50	82.92
DCH-519	1.14	1.36	1.29	5.41	4.66	1.05	84.50
GCH-5	2.29	1.44	1.75	6.86	4.31	3.00	81.76
GCH-7	2.89	1.36	1.57	5.18	4.61	2.08	85.67
Mean	1.97	1.40	1.40	6.08	4.68	1.53	84.36
SEM±	0.18	0.01	0.04	0.36	0.03	0.15	0.48
SD	0.74	0.04	0.16	1.48	0.13	0.60	2.00

Table 3 Correlation coefficient between different seed and quality characteristic parameters of castor hybrids

	Seed oil content (%)	Kernel oil content (%)	Kernel (%)	Seed coat (%)	Specific gravity	Refractive Index)	Viscosity (cp)	% FFA as Oleic acid	C16:0 Palmitic	C18:0 Stearic	C18:1 Oleic	C18:2 Linoleic	C18:3 Linolenic	C18:1 (OH) Ricinoleic
100 Seed wt. 0.208	0.046	-0.095	0.095	-0.168	-0.121	-0.377	0.131	0.252	0.104	-0.141	-0.046	0.097	0.087	
Seed oil content (%)	0.404	-0.355	0.355	0.017	0.071	0.324	-0.045	-0.106	-0.230	-0.048	0.431	-0.257	0.268	
Kernel oil content (%)		-0.402	0.402	0.151	0.070	0.191	0.186	0.355	-0.151	0.219	0.239	-0.111	0.001	
Kernel (%)			-1.000**	-0.105	-0.185	-0.232	-0.279	-0.406	0.086	-0.323	-0.337	0.077	0.367	
Seed coat (%)				0.105	0.185	0.232	0.279	0.406	-0.086	0.323	0.337	-0.077	-0.367	
Specific gravity					0.934**	0.546*	-0.618**	0.010	-0.920**	0.223	0.745**	-0.901**	-0.027	
Refractive Index						0.581*	-0.589*	0.051	-0.867**	0.373	0.758**	-0.841**	-0.254	
Viscosity (cp)							-0.257	-0.163	-0.544*	0.381	0.436	-0.557*	-0.175	
% FFA as Oleic acid								-0.084	0.563*	0.252	-0.368	0.561*	-0.18	
C16:0 Palmitic									0.103	0.318	-0.114	0.186	-0.497*	
C18:0 Stearic										-0.162	-0.846	0.989**	-0.166	
C18:1 Oleic											0.09	-0.059	-0.782**	
C18:2 Linoleic												-0.864**	0.161	
C18:3 Linolenic													-0.248	

affecting of fatty acid and oil properties is the degree of unsaturation. Being a product of hydrolytic degradation of triglycerides, their amount is considered as an important quality index for oils. Free fatty acids (FFAs) are included amongst compounds naturally present in low amounts in vegetable oils. The value of free fatty acid as oleic acid is varied from 1.09 % (SHB-977) to 3.05 % (PCH-248). The free fatty acid was negatively correlated with specific gravity (r = -0.614**) and refractive index (r = -0.593*). Measures of FFAs is usually considered to be one of the main parameters to reflect the quality of vegetable oils, degree of refining, as well as the quality change during storage. However, the oil of high value of free fatty acid could be modified by subjecting it to refining and this would also improve its quality for industrial usage. This could be used to check the level of oxidative deterioration of the oil by enzymatic or chemical oxidation. The fire, flash and smoke points of the oil has linear relationship with the content of the free fatty acid present in the oil (AOAC, 1990), which is a good indicator of the advantageous utilization of the oil in soap making. A good quality castor oil should have the acid value within the range of 3-4 (Kulkarni and Ramanamurthy, 1977). Expelled castor oil has generally of low fatty acidity (<3) while solvent extracted oils has higher acid value than the required standard.

Among the fatty acid profiles, the variability for palmitic, stearic, oleic, linoleic, linolenic and ricinolic acids were also recorded. The saturated fatty acids, palmitic and stearic acids were in range of 1.34 to 1.51% and 1.26 to 1.75%, respectively. Excess carbohydrates are converted to palmitic acid. Palmitic acid is the first fatty acid produced during fatty acid synthesis and the precursor to longer fatty acids. Stearic acid had significant positive correlations with the FFA as oleic acid (r=0.563*). The oleic acid content varied from 4.37% (PCH-248) to 10.54 % (SHB-918). Higher value of oleic acid is a desirable trait for high oxidative stability, hence suitability of castor oil for bio-diesel, or pharmaceutical application (Rojas *et al.*, 2004). The biosynthesis of oleic acid involves the action of the enzyme stearoyl-CoA 9-desaturase acting on stearoyl-CoA. In effect, stearic acid is dehydrogenated to give the monounsaturated derivative oleic acid. The poly unsaturated fatty acid like linoleic and linolenic fatty acid were in the range of 4.31 to 4.86 and 0.99 to 3.00, respectively. Both Linoleic and Linolenic fatty acids was significantly positively correlated with stearic (r= 0.846**) and (r= 0.989**), respectively. Both Linoleic and Linolenic fatty acids was significantly positively correlated (r= 0.864**) with each other under the study.

Ricinoleic acid, the predominant mono unsaturated fatty acid varied among castor hybrids from 81.21 (RHC-277) to 87.79% (SHB-875). The functional group causes ricinoleic acid to be unusually polar and also allows chemical derivatization that is not practically possible with most other vegetable oils. It is the hydroxyl group which makes castor oil ricinoleic acid valuable as chemical feed stocks. Under the present study the ricinolic acid content was significantly negatively correlated with oleic fatty acid (r=-0.782**); and palmitic fatty acid (r=-0.497*). The fatty acid profile resembled with the findings of Lakshminarayana *et al.* (1984).

On the basis of present study, it could be inferred that there are variations in the seed characteristics and fatty acid profile due to genotypic differences. Among hybrids studied, SHB-875 has better seed oil content and ricinolic acid. The present study will be helping for the better castor hybrid development.

REFERENCES

Abitogun, A., Alademeyin, O. and Oloye, D. 2009. Extraction And Characterization Of Castor Seed Oil. *The Internet Journal of Nutrition and Wellness.* **8** (2). DOI: 10.5580/147f.

Abolfazl, A., Nasrin F., Habib,S., Saeid, H. 2011. The Effect of Climatic Factors on the Production and Quality of Castor Oil. *Nature and Science,* **9** (4): 15-19.

Akpan, U.G., Jimoh, A., Mohammed, A.D. 2006. Extraction, Characterization and Modification of Castor Seed Oil. *Leonardo Journal of Sciences.* **8**: 43-52.

AOAC 1990. Official Method of Analysis 14th Edn. Vol. 67, Association of Official Analytical Chemists Arlington, VA, Washington DC, USA: pp. 1-45.

AOCS 1951. Official and Tentative Methods. *Ed* 2, rev. to 1951, Chicago: pp. 1946–51.

FAO, 2013. www.faostat.fao.org. Food and Agriculture Organization of United Nations, Rome, Itly.

Kulkarni, L.G. and Ramanamurthy, G.V. 1977. Chemistry and technology of castor oil, castor cake and castor stalks. In *Castor.* Indian Council of Agricultural Research, News Delhi, pp 74.

Lakshminarayana, G., Paulose, M.N. and Neeta Kumari, B. 1984. Characteristics and composition of newer varieties of Indian Castor seed and oil. *Journal of American Oil Chemists' Society,* **61**: 1871-1872.

Lavanya, C., Murthy, I.Y.L.N., Nagaraj, G. and Mukta, N. 2012. Prospects of castor (*Ricinus communis L.*) genotypes for biodiesel production in India. *Biomass and Bioenergy,* **39**: 204-209.

Moskin, V.A.. 1986. Economic importance and regions of cultivation of castor. Castor. Oxonian Press Pvt. Ltd. New Delhi. pp.1-75.

Nagraj, G. 1995. Quality and Utility of oilseeds. Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030. pp. 41-43.

Patel, M.K., Pathak, H.C., Raj, A. D. and Desai, K. J. 2004. Quality characteristics of some castor, *Ricinus communis* L hybrids and varieties. *Journal of Oilseed Research.* **21** (1): 210-211.

Rojas, B. P., Haro, A. D., Munoz, J. and Martinez, J.M.F. 2004. Isolation of a natural mutant in castor with high oleic/low ricinoleic acid content in the oil. *Crop Science.* **44**:76-80.

Shah, S.K., Patel, D.K., Patel, R.M., Patel, P.S. and Patel, D.U. 2013. Seed and oil quality characteristics of some castor (*Ricinus Communis* L.) genotypes. *Journal of Oilseed Research.* **30**(2):174-176.

GAU Research Journal **40** (2) : 92-95 July 2015

Effect of sources and rates of sulphur on yield and quality of summer groundnut (*Arachis hypogaea* L.) under north Gujarat condition

V. V. CHAUDHARI[1] AND J. M. PATEL[2]

Department of Agricultural Chemistry & Soil Science
C. P. College of Agriculture,
S. D. Agricultural University, Sardarkrushinagar - 385 506 (Gujarat)

Received : 9 December, 2013

ABSTRACT

A field experiment was conducted at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) in summer 2012 to study the effect of sources and rates of sulphur on yield and quality of summer groundnut under north Gujarat condition. Sources of sulphur failed to express their significant effect on yield attributes, pod and haulm yield and quality parameters of groundnut. Among the sulphur levels, application of 45 kg S ha^{-1} recorded significantly higher value of yield attributes *viz.*, number of filled pods $plant^{-1}$ (31.92), numbers of pods per plant (34.81), 100 kernal weight (41.95 g) and shelling percentage (69.83 %) over rest of the treatments but it remained at par with 30 and 60 kg S ha^{-1} in case of number of filled & total pods/plant while in case of 100 kernel weight & shelling percentage, it was fond at par with 60kg S/ha^{-1}. Significantly higher pod weight $plant^{-1}$ (24.37 g) was recorded under 60 kg S ha^{-1} but it was found at par with 45 kg S ha^{-1}. The pod and haulm yield were also significantly increased with successive increase in the levels of sulphur up to 45 kg ha^{-1}. Significantly higher pod (2784 kg ha^{-1}) and haulm yield (3792 kg ha^{-1}) were recorded with of 45 kg S ha^{-1} than other treatments. In case of quality parameters, significantly highest oil (47.87%) and protein content (23.96%) were noticed with 60 kg S ha^{-1}, but it remained at par with 30 and 45 kg S ha^{-1} whereas significantly higher oil yield (927.0 kg ha^{-1}) was recorded under 45 kg S ha^{-1}, however it was found at par with 60 kg S ha^{-1}.

Key words : Sulphur, groundnut, sources and rates

Gujarat ranks first in area and production of groundnut in India. However, average productivity is relatively low as groundnut is mostly grown under rainfed condition. Because of high productivity under assured irrigation, groundnut cultivation in summer season is gaining popularity. In Gujarat, groundnut is largely grown under rainfed condition and yield is influenced due to erratic rainfall, the scope of increasing area under *kharif* groundnut is limited. Due to favorable climatic condition in north Gujarat, growing of summer groundnut emerged a potential crop in the loamy sand soil provides assured production than the rainy season crop. Dodiya (1985) visualized higher yield potential of summer groundnut grown in loamy sands soil of North Gujarat. Irrespective of the crops, sulphur is now rightly called the fourth major plant nutrient next only to nitrogen (N), phosphorus (P) and potassium (K) but for oilseed crops, it is as important as P. It is very important for oilseed crops because it is essential for the protein production and activation of enzymes. It is involved in the metabolic and enzymatic processes of all living cells. It is the constituent of the amino acids like cystine and methionine. It is also involved in the formation of glucosides or glucosinolates, which on hydrolysis increase the oil content. Likewise, it plays an important role in chlorophyll and vitamin formation (Gosh e*rt al.*,2000). The available S status of the soils in Gujarat indicated average per cent deficiency of 44.3% in North Gujarat, which was the highest in the state (Patel et al., 1986). It is due to growing of high yielding varieties, intensive cropping resulting higher rate of S removal by the crops

[1] Junior Executive, Reliance Industry Ltd., Jamnagar,
[2] Assistant Research Scientist, Central Instrumentation Laboratory

and lesser use of S containing fertilizers. Gypsum has been found either superior or equal to other S containing fertilizers in groundnut (Ghosh *et.al.*, 2000). Keeping the above considerations in view, attempts have been made through the present investigation to study the effect of different sources and rates of sulphur on summer groundnut.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) during summer season of 2012 to investigate the effect of sources and rates of sulphur on yield and quality of summer groundnut under north Gujarat condition. The soil of the experimental plot was loamy sand in texture having pH 7.50 with low in organic carbon, available nitrogen and sulphur, while medium in available phosphorus and potassium. The experiment consisted of 8 treatment combinations including two sources of sulphur *viz.*, Elemental sulphur (S_1) and Gypsum (S_2) and four levels of sulphur *viz.*, 15(L_1), 30 (L_2), 45 (L_3) and 60 (L_4) kg S ha^{-1} These treatment combinations were laid out in randomized block design with factorial concept having four replications. The crop was sown at 30 cm row spacing using 120 kg seeds/ha during second fortnight of February. The bunch type groundnut variety Gujarat groundnut- 2 (GG 2) was used. Common dose of 25 kg N and 50 kg P_2O_5 was applied through of DAP and urea as basal. Elemental sulphur was applied 23 days prior to sowing as per treatment as basal to provide time for decomposition of the chemicals, while gypsum was applied at the time of sowing. Total twelve irrigation were given to the groundnut crop. Two spray of systematic insecticide were carried out for control of sucking pest. The crop was harvested on during second week of June. Oil content in the kernel was estimated by Nuclear Magnetic Resonance Spectrophotometer (NMRS).

RESULTS AND DISCUSSION

Sources of Sulphur

The results indicated that different sources of sulphur had no significant effect on the yield attributes *viz.*, number of filled pods per plant, number of pods per plant, 100 kernal weight and shelling percentage as well as pod and haulm yield of groundnut (Table 1). This is ascribed to similar response of both sources on growth and yield parameters of groundnut. These results are in conformity with those reported by Patel *et al.*, (2008) emphasizing equal performance of all sources (Gypsum and elemental sulphur) on the yield of groundnut.

None of the sources had significant effect on oil and protein content as well as oil yield, however numerically higher value of oil content (46.81 %),

Table 1 Effect of sources and levels of sulphur on yield attributes and yield of groundnut

Treatment	No. of filled pods/ plant	Number of Pods/ plant	Pod weight (g/plant)	Shelling percentage (%)	100 kernel weight (gm)	Pod yield (kg/ha)	Haulm yield (kg/ha)
Sources of sulphur							
S_1 : Elemental sulphur	30.52	33.56	22.40	69.11	39.43	2540	3591
S_2 : Gypsum	30.19	33.25	22.63	68.89	40.36	2581	3588
S.Em. ±	0.59	0.612	0.43	0.271	0.81	52.61	74.79
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS
Levels of sulphur (kg/ ha)							
L_1 : 15.0	28.36	31.61	20.04	68.12	37.12	2283	3338
L_2 : 30.0	29.40	32.55	21.50	68.36	38.79	2399	3463
L_3 : 45.0	31.92	34.81	24.14	69.83	41.95	2784	3792
L_4 : 60.0	31.74	34.65	24.37	69.50	41.72	2774	3767
S.Em. ±	0.83	0.87	0.61	0.322	1.15	74.41	105.77
C.D. at 5 %	2.45	2.54	1.79	0.95	3.38	218.80	311.02
Interaction (SxL)	NS	NS	NS	NS	NS	NS	NS
C.V. %	7.75	7.33	7.66	1.33	8.14	8.22	8.33

Table 2 Effect of sulphur application on quality parameters of groundnut

Treatment	Protein content (%)	Oil content (%)	Oil yield (kg/ha)
Sources of sulphur			
S_1 : Elemental sulphur	23.08	46.61	821.3
S_2 : Gypsum	23.42	46.81	832.8
S.Em. ±	0.24	0.48	16.78
C.D. at 5%	NS	NS	NS
Levels of sulphur (kg/ ha)			
L_1 : 15.0	22.23	45.17	704.8
L_2 : 30.0	23.04	46.19	761.0
L_3 : 45.0	23.77	47.61	927.0
L_4 : 60.0	23.96	47.87	915.4
S.Em. ±	0.34	0.68	23.73
C.D. at 5%	1.01	1.99	69.78
Interaction (S×L)	NS	NS	NS
C.V. %	4.17	4.10	8.12

protein content (23.42 %) and oil yield were (832.8 kg/ha) were recorded with gypsum.

Levels of Sulphur

Among the sulphur levels, application of sulphur @ 45 and 60 kg/ha^{-1} did not significantly vary from each other in respect to weight of pods per plant and shelling percentage showed their significant superiority over lower levels. Application of 45 kg S ha^{-1} registered significantly higher number of filled pods per plant (31.92), number of pods/plant (34.81) and 100 kernel weight (41.95 g) but it was found at par with 30 and 60 kg S ha^{-1}.

A linear increase in pod and haulm yield was observed up to 45 kg S ha^{-1}. Application of 45 kg S ha^{-1} produced significantly higher pod (2784 kg/ha) and haulm yield (3792 kg/ha) of groundnut than rest of the S levels, however it was found at par with 60 kg S ha^{-1}. Application of 45 kg S ha^{-1} increased the pod yield to the tune of 16.04 and 21.94 percent over 30 and 15 kg S ha^{-1}, respectively. The increase in pod and haulm yield is mainly ascribed to improvement in yield attributes *viz.* number of filled pods plant^{-1}, total pods per plant, 100 kernal weight and shelling percentage (Table 1) with S application in addition to its multiple role in metabolism as an essential constituent of amino acids and also improvement in vegetative structure, production of reproductive structures and assimilates thereby maintaining balance source and sink. These results are in close conformity with the findings Nayak *et al.* (2004), Patel *et al.*, (2008) and Ramdevputra *et al.*, (2010).

Application of sulphur brought significant improvement in quality of groundnut. Application of sulphur @ 60 kg ha^{-1} gave significantly higher protein (23.96 %) and oil content (47.87 %) over rest of the treatment but it was found statistically at par with 30 and 45 kg S ha^{-1} (Table 2). Significantly higher oil yield (915.4 kg/ha) was produced with 60 kg S ha^{-1} than lower levels of S but it remained at par with 45 kg S ha^{-1}. The increase in protein content also might be due to increase in nitrogen content in kernels as well as nitrogen uptake by groundnut crop with S application, as nitrogen is an integral part of chlorophyll and also a major content of protein. These results are in conformity with those reported by Dayanand (2003). The increase in oil content might be due to Sulphur application, as it is required for synthesis of S containing amino acids, protein and oils. The highest oil yield was recorded with higher rate of sulphur (60 kg/ha) is attributed to high oil content and pod yield by respective treatment. The results are in conformity with those reported by Dayanand (2003) and Patel *et al.*, (2008).

CONCLUSION

It is concluded from the foregoing results that summer groundnut crop should be fertilized with 45 kg S/ha through either gypsum or elemental sulphur in addition to recommended dose of fertilizer (25:50 kg NP/ha) through urea and DAP for getting higher pod yield and net return. Application of sulphur also improves the quality of the groundnut.

REFERENCES

Dayanand. 2003. Influence of inter crops and sulphur on nutrient uptake and food value of groundnut. *Indian Society of Oilseed Research*, **28-30**:175-176.

Dodia, I. N. 1998. Response of *kharif* groundnut (*Arachis hypogaea* L.) to various *rhizobium* strains with different levels of sulphur and phosphorus. Ph.D. Thesis, Gujarat Agricultural University, Sardarkrushinagar.

Ghosh, P. K. Hati, K. M., Mandal K. G., Mira, A. K., Chaudhary, R.S. and Bandyopadhyay, K. K. 2000. Sulphur nutrition in oilseed based cropping systems. *Fertilizer News* **45**(8):27-40.

Nayak. S. C. Sahu, S. K. Sarangi, D. and Pradhan, K. C. 2004. Evaluation of efficiency of source and levels of sulphur for groundnut in lateritic soil. *International Arachis News.* **24**:48-49.

Patel, G. N. Patel, P. T. Patel, P. H. and Patel, R. M. 2008. Irrigation and sulphur management in summer groundnut, Arachis hypogaea L. under North Gujarat conditions. *Journal of Oilseeds Research*, **25**(1):35-37.

Patel, M. S., Gundalia, J. D. and Golakia, B. A. 1986. Sulphur status in Gujarat soils in relation to oilseeds and pulses. Paper Presented in 24th meeting of Agronomy and Soil Science sub-committee of Research Council held at Navsari Campus of Gujarat Agricultural University, May, 21-23.

Ramdevputra, M. V. Akbari, K. N. Sutaria, G. S. Vora, V. D. and Padmani, D.R. 2010.Effect of sulphur application on yield of groundnut and soil fertility under rainfed conditions. *Legume Research*, **33** (2):143-145.

GAU Research Journal **40** (2) : 96-99 July 2015

Participation of dairy farm women in animal husbandry practices in Mehsana district of north Gujarat.

P. M. PRAJAPATI [1], A. S SHEIKH[2] AND H. K. DESAI[3]

Department of Veterinary and A.H. Extension Education
College of Veterinary Science and Animal Husbandry
S. D. Agricultural University, Sardarkrushinagar-385 506 (Gujarat)

Received : 4 August, 2014

ABSTRACT

In India, women's involvement in livestock management is a age old tradition and livestock rearing is an integral part of homestead farming system. Animal husbandry activities are performed by dairy farm women besides fulfilling their responsibilities as home makers. Moreover, the knowledge and skill of the dairy farm women and their participation in decision-making certainly affects effectively in their work, effectively. The study was conducted in Vijapur and Mehsana talukas of Mehsana district, where production of milk was highest as compared to other talukas. Ten villages having the larger number of females in milk producer' co-operative societies were selected purposively. The dairy farm women were selected by single stage random sampling method. The sample consisted of 120 respondents for the study. A large majority (89.16 per cent) of the dairy farm women had medium to high extent of participation in animal husbandry practices. The results of correlation analysis indicated that out of 17 independent variables, 14 independent variables *viz.*, education, social participation, land holding, time spent in dairy activities, herd size, expenditure on dairy animals, occupation, annual income, mass media exposure, extension contact, scientific orientation, risk orientation, knowledge level regarding recommended animal husbandry practices, participation in decision making, were found positively and significantly correlated with extent of participation of dairy farm women in animal husbandry practices.

Key words : Dairy, animal husbandry practices, farm women

Women's contribution to national development is crucial. Emancipation of women is in essential pre-requisite for economic development and social progress of the action. Women play an important and vital role in animal husbandry practices as manager, decision makers and skilled workers. The contribution of dairy farm women in terms of time and effort is not low or less than men. In India, women's involvement in livestock management is a age old tradition and livestock rearing has been as integral part of homestead farming system. Animal husbandry activities are performed by dairy farm women besides fulfilling their responsibilities as home makers. Moreover, the knowledge and skill of the dairy farm women and their participation in decision-making certainly affects effectively in their work effectively. Looking to these facts, the present investigation was planned with following objectives :

[1] To study the extent of participation of dairy farm women in animal husbandry practices.

[2] To study the relationship between profile of dairy farm women and their extent of participation in animal husbandry practices.

METHODOLGY

The present investigation was purposively carried out in Vijapur and Mehsana talukas of Mehsana district, where production of milk was highest as compared to other talukas. Ten villages having the larger number of females in milk producers' co-operative societies were selected purposively. To select the respondents for this study, a list of dairy farm women who have

[1] & [3] P.G. Student, [2] Associate Professor & Head

started dairy occupation since last five years was obtained from the village milk producers' co-operative society of each of the selected villages. Thereafter, twelve respondents were selected from every village by single stage random sampling method. In this way, the sample consisted of 120 respondents. The data were collected by personal contact method with the help of structured interview schedule. The collected data were coded, classified, tabulated and analyzed in order to make the findings meaningful in light of objectives for drawing meaningful interpretation.

RESULTS AND DISCUSSION

Extent of participation dairy women in animal husbandry practices

In order to know the level of participation, the participation index of each respondent was calculated. Thereafter, the respondents were grouped on the basis of mean and standard deviation. The data in this regard are presented in Table 1.

Table 1 Distribution of dairy Farm Women according to their extent of participation in Animal Husbandry Practices (N=120)

Sr. No.	Category	Frequency	Per cent
1.	Low (less than 53.89 score)	13	10.83
2.	Medium (in between 53.89 to 73.43 score)	84	70.00
3.	High (above 73.43 score)	23	19.16
	Total	120	100.00

Mean = 63.66 S.D. = 9.773

Revealing the data in Table, 1 nearly two- third (70.00 per cent) of the dairy farm women had medium extent of participation in animal husbandry practices, followed by high (19.16 per cent) and low (10.83 per cent) extent of participation in animal husbandry practices.

It can be concluded that a large majority (89.16 per cent) of the dairy farm women had medium to high extent of participation in animal husbandry practices.

The probable reason for above finding may be due to their better experience in animal husbandry practices, higher income and literacy level, better mass media exposure, extension contact and high level of scientific orientation. All these factors might have led their better participation in animal husbandry practices. This finding is similar to the findings reported by Parte (2003), Narmatha *et al.* (2009). Study in Tamilnadu and Anand.

Relantionship between profile of dairy farm women and their extent of participation in animal husbandry practices

Participation is not an unique act but complex process involving sequence and thought of action. The action of an individual dairy farm woman is governed by physical, social, economical, psychological and cultural factors involved in situation. Some dairy farm women participate more actively than other in animal husbandry practices because of the difference in personal characteristics.

Similarly, if there is difference in economic factors, the process of action is changed and thereby changing the pattern of participation. In nutshell, it may be stated that the extent of participation is differed when there is difference in physical, personal, social, economical, psychological, and cultural traits of dairy farm women. Hence, considering the importance of this traits and review of past research studies, an attempt has been made in this dimension to ascertain the relationship occurs if any, between personal, social-economical, communicational and psychological characteristics of dairy farm women. This was determined by using Karl Pearson's coefficient of correlation and the result thus obtained are presented in Table 2.

The results of correlation analysis narrated in Table, 2 indicated that out of 17 independent variables, 14 independent variables *viz.*, education, social participation, land holding, time spent in dairy activities, herd size, expenditure on dairy animals, occupation, annual income, mass media exposure, extension contact, scientific orientation, risk orientation, knowledge level regarding recommended animal husbandry practices, participation in decision making, were found positively and significantly correlated with extent of participation of dairy farm women in animal husbandry practices. Remaining

Table 2 Zero order correlation coefficients between the personal, social, economical, communicational and psychological characteristics of dairy farm women and their extent of participation

(N=120)

Sr. No.	Independent variable	Correlation coefficients ('r' values)
I.	Personal	
	1. Age	-0.124 NS
	2. Education	0.310 **
	3. Experience in animal husbandry practices	0.026 NS
II.	Social	
	4. Size of family	-0.075 NS
	5. Social participation	0.299 **
III.	Economical	
	6. Size of land holding	0.209 *
	7. Time spent in dairy activities	0.314 **
	8. Herd size	0.282 **
	9. Expenditure on dairy animals	0.400 **
	10. Occupation	0.421 **
	11. Annual income	0.233 **
IV.	Communicational	
	12. Mass media exposure	0.238 **
	13. Extension contact	0.256 **
V.	Psychological	
	14. Scientific orientation	0.241 **
	15. Risk orientation	0.318 **
	16. Knowledge level regarding recommended animal husbandry practices	0.236 **
	17. Participation in decision-making	0.408 **

* Significant at 0.05 level of probability.
** Significant at 0.01 level of probability

variables viz.; age, experience in animal husbandry practices, size of family, were failed to establish any significant relationship with extent of participation of dairy farm women in animal husbandry practices. This finding is in line with the finding reported by Ray *et al.*(2004) and Upadhyay (2010).

CONCLUSION

Nearly two- third (70.00 per cent) of the dairy farm women had medium extent of participation in animal husbandry practices, The results of correlation analysis indicated that out of 17 independent variables, 14 independent variables *viz.*, education, social participation, land holding, time spent in dairy activities, herd size, expenditure on dairy animals, occupation, annual income, mass media exposure, extension contact, scientific orientation, risk orientation, knowledge level regarding recommended animal husbandry practices, participation in decision making, were found positively and significantly correlated with Extent of participation of dairy farm women in animal husbandry practices. Remaining variables *viz.*, age, experience in animal husbandry practices, size of family, were failed to establish any significant relationship with Extent of participation of dairy farm women in animal husbandry practices.

REFERENCES

Narmatha, N., Uma, V., Arun, L. and Geetha, R. 2009. Level of participation of women in livestock farming activities, *Tamilnadu Journal of Veterinary & Animal sciences,* **5**(1) :4-8.

Parte, L. 2003. participation of women members in dairy co-opertive societies of Anand district, M.Sc. (Agri) Thesis, GAU, Anand.

Pearson, K. 1954. Essay in sociological Theory, The Free Press, Glencore : 275.

Ray, M. N. and Chowdhury, R. K. 2004. Variables influencing the participation of scheduled caste women in animal husbandry activities in the Hajo Development block of Assam, *Rural India,* Feb-March :56-59.

Toppo, A. 2005. A study of participation and decision making of farm women in dairy occupation in Anand district of Gujarat state, M.Sc. (Agri.) Thesis, AAU, Anand.

Upadhayay, S. 2010. "Participation of Dairy farm women in animal husbandry occupation." M.Sc. (Agri.) Thesis, AAU, Anand.

GAU Research Journal **40** (2) : 100-104 July 2015

Extent of agricultural modernization among the tribal and non-tribal farmers of Sabarkantha district of Gujarat state

MAYUR PRAJAPATI [1], K. D. SOLANKI [2] AND ALPESH PRAJAPATI [3]

Department of Extension Education, C. P. College of Agriculture,
S. D. Agricultural University, Sardarkrushinagar-385 506 (Gujarat)

Received : 23 July, 2012

ABSTRACT

Agricultural modernization means improvement in farming system, infrastructure facilities, promotion of cultivation practices, crop diversification and value addition process. Agricultural modernization is not purely technological or economic problem. It is frequently dependent on an understanding of the society in which it is to take place, a knowledge of the social and cultural factors that condition farmers responsiveness to technological change is essential. The present study was conducted in Sabarkantha district of North Gujarat region of Gujarat state as the economy of the district is basically dependent on agriculture as 62.8% workers are engaged in primary sector. The farmers of Sabarkantha district are innovative as well as enthusiastic in modern agriculture. Secondly the district ranks first with respect to tribal population amongst the districts of North Gujarat region It is seen that only 14 villages out of 1,372 were having percentage range of scheduled tribes population of 41-50; covered in Khedbrahma, Vijaynagar, Bhiloda, and Meghraj talukas of the district. Among these four talukas considering the numbers of villages Meghraj and Bhiloda talukas were selected purposively. Looking to the common situation of the inhabited villages for the tribal and non-tribal farmers, all 11 villages of Bhiloda and Meghraj talukas, having scheduled tribes population of 41-50 range of percentage were selected purposively. Ten tribal farmers and Ten non-tribal farmers from each village were selected randomly. Thus, total 220 farmers were selected. To measure the agricultural modernization of the farmers a teacher made test was developed. The teacher made test of agricultural modernization of the farmers was consisted of major thirteen criteria and each criteria was given score by conference method of the teachers. Then, total 200 score of agricultural modernization test was determined. The majority of the tribal (84.55%) and non-tribal (85.46%) of the respondents having low to medium extent of AMI. The tribal farmers differ significantly from non-tribal farmers with respect to their extent of AMI. The independent variables *viz.*, age, size of family, land holding, livestock possession and cosmopoliteness were found significantly related with AMI of tribal respondents, In case of non-tribal respondents all 10 selected independent variables were found to be significantly associated with AMI.

Key words : Tribal, non-tribal, agricultural modernization

It is now realized the world over that in order to meet food requirement of the growing population and rapid industrialization, modernization of agriculture is inescapaple. Agriculture is one of the crucial and mega sector in the Indian economy which contributes about 27% to the GDP. Agricultural scenario in our country is undergoimg a rapid change. In this context food and nutritional security, poverty allevation, diversifying market demands, export opportunities and environment concerns are the new challenges to technology dissemination system. To respond to these challenges, appropriate agricultural technologies and agro-management practices are to be developed and disseminated among the users. Modernization of agriculture through improvement in infrastructure facilities and at sub sector specific strategies include promotion of various package of practices were also emphasized during Tenth Five year plan. These features of Indian agriculture widened the gap

[1] & [3] P. G. Student, [2] Ex Associate Director of Extnesion Education, Directorate of Extension Education

between commodity based demands and supply, hence could not helped the farmers in terms of economic benefits. Among them crop diversification is vital to ensure food security and to provide balanced diet through nutritive products to poor people. (Raveendarn *et.al.*, 2003). Therefore, the only alternate left for marching with the time is to go with the diversification as well as modernizations of agriculture and animal husbandry production both in terms of time and space as per need and requirement of the ever-growing population to ensure their food security. The phenomenon of demand driven agriculture is still far behind with the farmers of backward regions and tribal areas.

India has the social largest tribal population in the world next to Africa. According to Census, 1991 there are 67.76 million tribals constituting (8%) of the country total population. The tribals in Gujarat from about 15% of total population. The Gujarat state is the fourth among states with sizeable tribal population, is concentrated in the North Districts to the Dangs district. Sabarkantha ranks first among the districts of the North-Gujarat with respect to tribal concentration and 15% tribal population to state total population. Looking to these facts, the present investigation was planned with following objectives :

[1] To study the agricultural modernization among the tribal and non tribal farmers.
[2] To ascertain the association between the personal, social, economical, situational, communicational attributes of the tribal and non tribal farmers and their agricultural modernization.

METHODOLGY

The present study was conducted in Sabarkantha district of North Gujarat region of Gujarat state as the economy of the district is basically dependent on agriculture as 62.8% workers are engaged in primary sector. The farmers of Sabarkantha district are innovative as well as enthusiastic in modern agriculture. Based on the backwardness index the planning commission has identified six tribal districts of Gujarat as disadvantaged. (Anonymous 2001) Out of these six districts two districts namely, Banaskantha and Sabarkantha are in North Gujarat. Considering the highest tribal population, Sabarkantha district was selected purposively. According to the Census-2001, proportion of scheduled tribes population to total population in villages are categorized in 9 different percentage ranges at district level, i.e. Zero percentage range of scheduled tribes population to 76 and above percentage range. It is seen that only 14 villages out of 1,372 were having percentage range of scheduled tribes population of 41-50; covered in Khedbrahma, Vijaynagar, Bhiloda, and Meghraj talukas of the district. These 14 villages, one village was in Khedbrahma taluka, two villages in Vijaynagar taluka, four villages in Meghraj taluka and seven villages in Bhiloda taluka. Among these four talukas considering the numbers of villages Meghraj and Bhiloda talukas were selected purposively. Looking to the common situation of the inhabited villages for the tribal and non-tribal farmers, all 11 villages of Bhiloda and Meghraj talukas, having scheduled tribes population of 41-50 range of percentage were selected purposively. Ten tribal farmers and ten non-tribal farmers from each village were selected randomly. Thus, total 220 farmers were selected.

To measure the agricultural modernization of the farmers a teacher made test was developed. The teacher made test of agricultural modernization of the farmers was consisted of major thirteen criteria *viz.*, farming pattern, seed selection, use of Irrigation system, use of underground pipe line for irrigation, use of transportation facility for marketing of agricultural production, available modern machinery and implements, available modern sources of energy equipments, extent of use of chemical fertilizers, extent of use of organic fertilizers, extent of use of storage facility, use of plant protection measures, extent of use of harvesting structures and extent of use of improved dairy practices. Such criteria were discussed with the experts of Extension Education, Agricultural Economics and Agronomy, then finally were included in the test. All possible factors were framed / included in order to have precise response and each criteria was given score by conference method of the teachers. Then, total 200 score of agricultural modernization test was determined.

The score obtained by an individual respondent for each of these criteria was summed up for his total agricultural modernization score. The index of

agricultural modernization was calculated for each individual respondent with the help of the following formula :

$$\text{Agricultural Modernization Index (AMI)} = \frac{\text{Sum of scores of all criteria rated by Individual}}{\text{Maximum score attributes to the all criteria rated.}} \times 100$$

RESULTS AND DISCUSSION

Extent of Agricultural Modernization Among the Tribal and Non-tribal Respondents

The only alternate left for marching with the time is to go with the diversification as well as modernizations of agriculture and animal husbandry production both in terms of time and space as per need and requirement of the ever-growing population to ensure their food security. The extent of agricultural modernization was studied. The respondents according to their extent of agricultural modernization index in Table 1.

The data presented in Table 1 reveal that in tribal farmers nearly two-thirds of the respondents (64.55 per cent) were having medium extent of agricultural modernization index, followed by 20.00 per cent of them had low extent of agricultural modernization, whereas only 15.45 per cent of them had high extent of agricultural modernization index. As well as data presented in Table 1 for non-tribal respondents two-thirds (66.36 per cent) were having medium extent of agricultural modernization index, while 19.10 per cent of them had low extent of agricultural modernization index, whereas only 14.54 per cent of them had high extent of agricultural modernization index. It can be concluded that majority of the tribal & non-tribal farmers were having low to medium extent of agricultural modernization index.

The 'Z' value was found highly significant (3.6728**) which implies that tribal farmers differ significantly from non-tribal farmers with respect to their extent of agricultural modernization index.

It was also observed that the low category of AMI among the tribal farmers was started from 17 score upto 28.78 score index while in the case of non-tribal farmers it was recorded from 21.5 upto 47.23 score index (*i.e.*, 64.11% higher) while in the high category of AMI among tribal and non-tribal respondent was recorded, above 62.20 score index and above 83.75 score index (i.e. 34.65% higher), respectively. which clearly indicated that there was great differentiation among the tribal and non-tribal respondents with respect to their AMI. These findings are similar to findings of Dattatraya (2001) and Solanki (2002).

Association between the personal, social, economical, situational, communicational attributes of the tribal and non tribal farmers and their agricultural modernization

To ascertain the associationship between independent variables and Agricultural modernization, zero order correlation was applied and the values of correlation coefficient (r) were calculated. These values have been given in Table 2.

Table 1 Distribution of the respondents according to their extent of agricultural modernization index.

(n = 220)

Sr. No.	Agricultural Modernization index	Tribal farmers		Sr. No.	Agricultural Modernization index	Non tribal farmers		'Z' value
		Number	Per cent			Number	Per cent	
1.	Low (Below 28.78)	22	20.00	1.	Low (Below 47.23)	21	19.10	3.6728**
2.	Medium(28.78 to 62.20)	71	64.55	2.	Medium (47.23 to 83.75)	73	66.36	
3.	High (Above 62.20)	17	15.45	3.	High (Above 83.75)	16	14.54	
	Total	110	100.00			110	100.00	
Mean : 45.49 S.D. : 16.71				Mean: 65.49 S.D.: 18.26				

** Significant at 0.01 level of significance

Table 2 Correlation coefficient of selected independent variables with agricultural modernization

(n = 220)

Sr. No.	Variables	'r' value	
		Tribal farmers	Non-tribal farmers
1	Personal variables		
	i Age	-0.3289 **	-0.2848**
	ii Education	0.1089 NS	0.2966**
2	Social variables		
	i Size of family	0.2088 *	0.2848**
	ii Social participation	0.0683 NS	0.2175*
3	Economic variables		
	i Land holding	0.1880 *	0.2410*
	ii Annual income	0.1405 NS	0.3662**
4	Situational variables		
	i Source of irrigation	0.1249 NS	0.2356*
	ii Livestock possession	0.1894 *	0.2835**
5	Communication variables		
	i Sources of information	0.0971 NS	0.2368*
	ii Cosmopoliteness	0.1982 *	0.2286*

* significant at 0.05 level of probability ** significant at 0.01 level of probability NS = Non significant

It is clear from Table 2 that out of 10 independent variables, the correlation of 4 variables *viz.*, size of family (0.2088), land holding (0.1880), livestock possession (0.1894) and cosmopoliteness (0.1982) were statistically found to be positively and significantly related with agricultural modernization index of tribal farmers at 0.05 level of significance. As far as the variables "Age" was concerned, the computed correlation coefficient was found to be negative but significantly related with AMI of tribal farmers at 0.05 level of significance. While the independent variables viz., education, social participation, annual income, source of irrigation and sources of information were concerned, the computed correlation coefficient were found to be non significant, this indicated that they did not establish any relationship with AMI of tribal farmers. It can be concluded that age, size of family, land holding, livestock possession and cosmopoliteness were the important variables affecting the agricultural modernization index among the tribal farmers.

The probable reason might be that age, size of family, land holding and livestock possession are mostly the components of personal, social and economic growth, respectively, which may have influenced the AMI of tribal farmers. In the case of non-tribal respondents, out of 10 selected independent variables, the correlation of 4 variables *viz.*, education (0.2966), size of family (0.2848), annual income (0.3662) and livestock possession (0.2835) were statistically found to be positively and significantly associated with AMI at 0.01 level of significance.

Among personal variables "Age" was found to be negative but significantly associated with AMI of non-tribal farmers at 0.01 level of significance. While the independent variables *viz.*, social participation (0.2175), land holding (0.2410), source of irrigation (0.2356), sources of information (0.2368) and cosmopoliteness (0.2286) were statistically found to be positively and significantly associated with AMI at 0.05 level of significance. This findings are in short supply with the findings of Jagdeeshwara *et.al.*, (1997). From the above discussion, it can be concluded that all the selected variables were very important variables affecting the AMI among the non-tribal respondents.

The probable reason might be that the non-tribal farmers (general farmers) have an enviable position in the Gujarat state among the all farming community with the rapid development of agriculture, discernible to the tribal farmers and the real benefits of modernization did not trickle down to the backward castes level.

CONCLUSION

It can be concluded that majority of the tribal and non-tribal farmers having low to medium extent of AMI. The tribal farmers differ significantly from non-tribal farmers with respect to their extent of agricultural modernization index. Out of selected 10 independent variables age, size of family, land holding, livestock possession and cosmopoliteness were found significantly related with AMI of tribal farmers, In case of non-tribal respondents all 10 selected independent variables were found to be significantly associated with AMI. It is indicated that all the selected variables were very important variables affecting the AMI among the non-tribal respondents. The non-tribal farmers have an enviable position in the Gujarat state among the all farming community with the rapid development of agriculture, discernible to the tribal farmers and the real benefits of modernization did not trickle down to the backward castes level.

REFERENCES

Anonymous. 2001. District census handbook of Sabarkantha (Census of India 2001) series-25, part-XII A & B, Directorate of Census operations, Gujarat.

Dattatraya, L. J. 2001. Modernization of Agriculture among the farmers of Mehsana district of Gujarat State. M.Sc. (Agri) Thesis, GAU, Sardarkrushinagar.

Jagadeeshwara, K. Patel, H. L., Katteppa, Y. (1997). A study in variation in modernization characterstics in among different catagaries of farmers in Kheda District of Gujarat State. *Journal of Extension Education*, **8** (2):19-27

Raveendaran, N.,N. Ajjan and S.R.Rajesh. 2003. Promotion of Sustainable Production, Value Addition and Increasing The Income and Employment Potentials. International Conference Agricultural Policies and Strategies for Profitable Farming: Field Realities, Needed Reforms and Interventions. Abstract : ICAR, New Delhi and College of Agriculture, G.A,U., Anand, Gujarat pp 1.

Solanki, K. D. (2002). Enterpreneurial behaviour of potato growers of North Gujarat Agroclimatic Zone of Gujarat State. Ph.D. Thesis, GAU Sardarkrushinagar.

GAU Research Journal **40** (2) : 105-108 July 2015

Optimum size and shape of plot for field experiments on wheat (*Triticum aestivum* L) under north Gujarat condition

R. I. PRAJAPATI[1], G. K. CHAUDHARY[2], B. H. PRAJAPATI[3] AND J. M. LORIA[4]

Department of Agril. Statistics, C. P. College of Agriculture,
S. D. Agricultural University, Sardarrushinagar- 385 506 (Gujarat)

Received : 08 November, 2014

ABSTRACT

An uniformity trial on wheat crop was conducted at Seed Technology Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of the year 2009-10 to determine optimum size and shape of plot for field experiments. Maximum curvature method and Fair field Smith's variance method were used for the purpose. Four rows each of one meter length *i.e.*, 0.90 m^2 area was considered as basic unit. A plot of 14.4 sq. m having 3.6 m. width x 4 m. length (*i.e.*, 16 rows each of 4 m length) with a rectangular shape of plot (net) was considered as optimum size and shape of plot for field experiments on wheat.

Key words : Optimum plot size, coefficient of variation, replications, wheat

Agricultural research workers are mainly concerned with field experimentation. Efficient planning of precise field experiments largely depends on adoption of principles of experimental design (Replication, Randomization and Local control), choice of experimental design and suitable size and shape of plot. Each experimental site has an inherent variation i.e. soil variability which could be accessed through uniformity trial. The studies of such variation help for proper choice in size and shape of plots and blocks, experimental design and number of replications etc. Such studies based on uniformity trials in Indian conditions were undertaken on various annual crops like Bajra (Patel and Patel, 1967); Paddy (Agrawal and Deshpande, 1967), Tobacco (Prajapati and Patel, 1984), Wheat (Kumar and Singh, 1986), Mungbean (Singh and Singh, 1989) and mustard (Prajapati *et al.*, 2013). However there is no information on optimum size and and shape of plot for wheat being predominantly irrigated cereal crop of North Gujarat. Therefore, the uniformity trial was conducted on wheat crop.

MATERIALS AND METHODS

The popular and high yielding variety Gujarat Wheat 322 was raised at a spacing of 22.5 cm. between two rows covering an area of about 0.40 hectare. The other crop cultivation practices in vogue were followed. A block of 20 m. x 18 m. was harvested and grain yield data were recorded separately for 400 basic units. The dimension of each basic unit was four rows of one meter length (0.9 m^2). Border areas were excluded from each side of experimental plot. The different sized plots of size 1, 2, 4, 5, 8, 10, 16, 25, 40, 50, 80 and 100 were formed by combining neighbouring units both length-wise as well as width-wise. The coefficient of variation for different combinations of above sized plots was calculated separately for grain yield data using the following formula.

$$\text{C.V. \%} = \frac{\text{Standard deviation}}{\text{General Mean}} \times 100$$

The optimum plot size was determined using maximum curvature method (Federer; 1955) and Fair-field Smith's variance law (Smith, 1938). The minimum number of replications (r) and area required for 5 % standard error of mean (SEm±) for different plot sizes were calculated as per (Nigam and Gupta, 1997) using the formula as $r = (\text{C.V. \%})^2 / (5\ \%\ \text{SEm})^2$. The relative land use efficiency was also calculated for different plot sizes.

RESULTS AND DISCUSSION

The comparisons were made among different sizes and shapes of plots using C.V. % obtained for grain yield of wheat. The results are given in Table-1 and

[1] & [2] Assistant Professor, [3] Professor & Head, [4] Statistical Assistant

Table 1 C. V. % per unit size for grain yield of wheat

No. of units	Combinations	C. V. %	Average C.V. % Per unit
	1x1	19.60	19.60
1	2x1	16.63	16.04
2	1x2	15.44	
	4x1	14.75	13.96
4	2x2	13.74	
	1x4	13.39	
	5x1	14.27	13.42
5	1x5	12.56	
	4x2	12.75	12.57
8	2x4	12.38	
	10x1	13.05	12.12
10	5x2	12.60	
	2x5	11.64	
	1x10	11.17	
16	4x4	11.16	11.16
20	20x1	12.46	11.49
	10x2	11.75	
	5x4	12.09	
	4x5	11.48	
	2x10	8.64	
	1x20	2.79	
25	5x5	11.38	11.38
40	20x2	11.33	8.38
	10x4	11.44	
	4x10	8.47	
	2x20	2.28	
50	10x5	10.91	9.70
	5x10	8.48	
80	20x4	11.21	6.64
	4x20	2.07	
100	20x5	10.79	7.62
	5x20	1.95	
	10x10	10.11	

depicted by Fig. 1. The results revealed that the coefficient of variation (C.V. %) decreased with increase in plot size. The average C.V. % decreased from 19.60 % to 7.62 % with increase in plot size from 1 unit to 100 units. Initially the decrease in C.V. % was more rapid but after 16 units plot size the reduction was marginal. These results are in agreement with the results reported by Kumar and Singh for wheat (1986), Prajapati *et al.* for mustard (2013), Prajapati *et al.* in bidi tobacco (1984) and Patel and Patel for Bajra (1967).

The difference between C.V. % of the consecutive points (plot size) may help to estimate per unit decrease in C.V. % and thereby point of maximum curvature. The results are given in Table 2. The per unit decrease in C.V. % was observed from 3.56 % to -0.05 % with increase in plot size from 1 units to 100 units plot size. Further look into the data clearly indicated that the reduction in C.V. % was more rapid in the beginning i.e. up to 16 basic units and then it decreased marginally. Thus, reduction in C.V. % was not proportional when plot size increased beyond 16 basic units. The same results graphically presented in Fig. 1 had showed the curvature more clearly.

Table 2 Per unit decrease in C. V % for grain yield of wheat.

Plot size in basic unit	Average C.V. %	Difference in C.V. %	Per unit decrease in C.V. %
1	19.60		
2	16.04	3.56	3.56
4	13.96	2.08	1.04
5	13.42	0.54	0.54
8	12.57	0.85	0.28
10	12.12	0.45	0.23
16	11.16	0.96	0.16
20	11.49	-0.33	-0.08
25	11.38	0.11	0.02
40	8.38	3.00	0.20
50	9.70	-1.32	-0.13
80	6.64	3.06	0.10
100	7.62	-0.98	-0.05

Table 3 Number of replications and area required for 5 per cent S. Em. and relative land use efficiency for grain yield with respect to unit plot size.

No. of basic unit plot size	C.V. %	No. of replications	Area required		Relative land use efficiency (%)
			No. of basic units	Sq. m.	
1	19.60	15	15	13.50	100.00
2	16.04	10	20	18.00	75.00
4	13.96	8	32	28.80	46.88
5	13.42	7	35	31.50	42.86
8	12.57	6	48	43.20	31.25
10	11.62	5	50	45.00	30.00
16	11.16	5	80	72.00	18.75
20	11.49	5	100	90.00	15.00
25	11.38	5	125	112.50	12.00
40	8.38	3	120	108.00	12.50
50	9.70	4	200	180.00	7.50
80	6.64	2	160	144.00	9.38
100	7.62	2	200	180.00	7.50

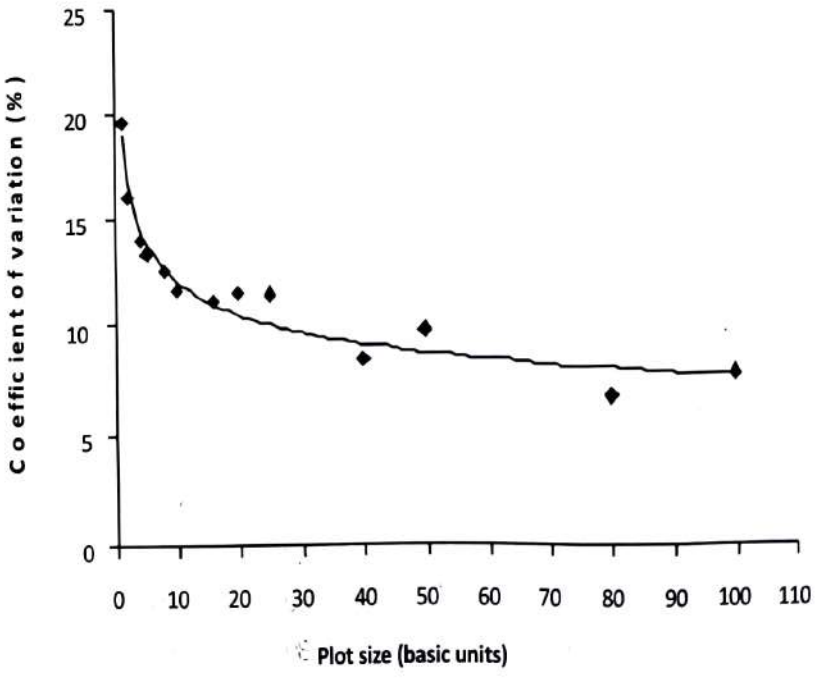


Fig. 1: Coefficient of variation in per cent for different sized plots

Therefore, 16 basic units plot size could be taken as point of maximum curvature (Federer, 1955) and appeared to be optimum plot size for field experiments on wheat crop.

The number of replication and required area for different plot size at 5 % standard error of mean were compared from the estimated C.V. % for grain yield of wheat by using the formula (Nigam and Gupta, 1997). The results are shown in Table 3. The results (Table-3) revealed that the number of replication and relative land use efficiency decreased as the size of plot increased. Agricultural operation in field experiment with smaller plot size, a plot size having relatively high land use efficiency with less number of replications should be considered for field experimentation. Such situation was observed with the 16 units plot size which is having considerably less number of replications and relatively high land use efficiency (Table 3) for grain yield. Therefore, 5 replications could be considered optimum for 16 units plot size at 5 % probability level for wheat crop.

CONCLUSION

A plot of 16 basic units size having shape of 16 rows each of 4 meters length (3.6 m × 4 m) was found as optimum plot size (net plot) with minimum 5 replications for field experiments on wheat at the Seed Technology Research Station, S. D. Agricultural University, Sardarkrushinagar

REFRENCES

Agrawal, K. N. and Deshpande, M. R. 1967. Size and shape of plots and blocks in field experiments with dibbled paddy. *Indian Journal of Agricultural Science*,**37 (6)** : 445-455.

Federer, W. T. 1955. Experimental design, theory and application. Mac Millan Co., New York 2nd ed., p. 58.

Kumar, P.R. and Singh, N.P. 1986. Analysis of Uniformity trial data with wheat. *Journal of Indian Society Agritulture Statistics*, **38**(3):310.

Nigam, A. K. and Gupta, V. K. 1979. *Handbook on Analysis of Agricultural Experiments, 1st edn.*, IASRI Publication, New Delhi, pp.3

Patel, N.M. and Patel R.M. 1967. Plot technique in Bajri. B.A.College Magazine, GAU, Anand, pp. 89-97

Prajapati, B. H., Chaudhary, G. K., Khokhar, A. N., Chaudhary. M. K., and Loria, J. M. 2013. Optimum size and shape of plot for field experiment on of mustard under North Gujarat condition. *GAU Research Journal*, **38** (1) : 32-35.

Prajapati, B. H. and Patel, N. M. 1984. Estimate of optimum plot size from uniformity data of bidi tobacco. *GAU Research Journal*, **9** (2) : 36-39.

Singh, H. P. and Singh, D. P. 1989. Optimum plot size for field experiment in mungbean. *Narendra Deva, Journal of Agricultural Research*, **4** (1) : 61-64.

Smith, H. F. 1938. An empirical law describing heterogeneity in the yields of agricultural crops. *Indian Journal of Agricultural Science*, **28**:1-23

GAU Research Journal **40** (2) : 109-112 July 2015

Estimation of optimum size and shape of plot for field experiments on isabgul (*Plantago ovata*)

G. K. CHAUDHARY[1], R. I. PRAJAPATI[2], B. H. PRAJAPATI[3] AND J. M. LORIA[4]

Department of Agril. Statistics, C. P. College of Agriculture,
S. D. Agricultural University, Sardarkrushinagar- 385 506 (Gujarat)

Received : 08 November, 2014

ABSTRACT

The optimum plot size for field experimentation on Isabgul crop was worked out using uniformity trial data. The popular methods, *viz.*, maximum curvature and fair field Smith's variance law were used for the purpose. One basic unit was fixed by taking 3 rows each of 1 meter length. A plot of 20 basic units size with shape of 12 rows each of 5 meters length (3.6 m x 5.0 m = 18.0 m^2) was found as optimum plot size (net plot) with 4 replications for field experiments on Isabgul at the Agricultural Research Station, S. D. Agricultural University, Kholvada.

Key words : Optimum plot size, coefficient of variation, replications, isabgul

Agricultural research workers are mainly concerned with field experimentation. Efficient planning of precise field experiments largely depends on the nature of experiments, variability present in experimental materials and the cost of various operations as well as the materials involved in conducting the experiment. Each experimental site has an inherent variation i.e. soil variability which could be accessed through uniformity trial. The studies of such variation help in proper choice in size and shape of plots and blocks, experimental design and number of replications etc. Such studies based on uniformity trials in Indian conditions were undertaken with various annual crops like Bajra (Patel and Patel, 1967); Paddy (Agrawal and Deshpande, 1967), Tobacco (Prajapati and Patel, 1984), Wheat (Kumar and Singh,1986), Mungbean (Singh and Singh, 1989) and mustard (Prajapati *et al.*, 2013). However there is no information on optimum size and shape of plot for Isabgul which is an important cash crop of North Gujarat. Therefore, the uniformity trial on Isabgul crop was conducted.

MATERIALS AND METHODS

The popular and high yielding variety Gujarat Isabgul-3 was sown at a spacing of 30 cm. between two rows covering an area of about 0.40 hectare the other crop cultivation practices in vogue were followed.

A block of 20 m. x 18 m. was harvested and seed yield data were recorded separately for 400 basic units. The dimension of one basic unit was three rows of one meter length (0.9 m^2). Border areas were excluded from each side of experimental plot. The different sized plots of size 1, 2, 4, 5, 8, 10, 16, 25, 40, 50, 80 and 100 were formed by combining neighbouring units both length-wise as well as width-wise. The coefficient of variation (C.V.) for different combinations of above sized plots was calculated separately using seed yield data as under.

$$\text{C.V. \%} = \frac{\text{Standard deviation}}{\text{General Mean}} \times 100$$

The optimum plot size was determined using maximum curvature method (Federer; 1955) and Fair-field Smith's variance law (Smith, 1938). The minimum number of replications (r) and area required for 5 % standard error of mean (S.Em.) for different plot size were calculated as per (Nigam and Gupta, 1997) using the formula as $r = (\text{C.V. \%})^2 / (5\ \% \text{ SEm})^2$. The relative land use efficiency was also calculated for different plot sizes.

RESULTS AND DISCUSSION

The comparisons were made among different sizes and shapes of plots using C.V. % obtained for seed yield of

[1] & [2] Assistant Professor, [3] Professor & Head, [4] Statistical Assistant

Table 1 C. V. % per unit size for seed yield of Isabgul

No. of units	Combinations	C. V. %	Average C.V. % Per unit
1	1x1	49.93	49.93
2	2x1	34.49	34.80
	1x2	35.11	
4	4x1	23.53	22.89
	2x2	23.58	
	1x4	21.56	
5	5x1	22.08	21.86
	1x5	21.63	
8	4x2	15.99	16.39
	2x4	16.78	
10	10x1	15.45	14.92
	5x2	15.25	
	2x5	13.70	
	1x10	15.29	
16	4x4	10.94	10.94
20	20x1	10.45	9.87
	10x2	10.45	
	5x4	9.91	
	4x5	8.40	
	2x10	9.00	
	1x20	11.03	
25	5x5	8.16	8.16
40	20x2	7.20	6.09
	10x4	5.92	
	4x10	5.61	
	2x20	5.61	
50	10x5	4.95	5.07
	5x10	5.18	
80	20x4	3.80	3.70
	4x20	3.60	
100	20x5	2.31	2.56
	10x10	2.53	
	5x20	2.83	

Isabgul. The results are given in Table 1 and depicted by Fig. 1. The results revealed that the coefficient of variation (C.V. %) decreased with increase in plot size. The average C.V. % decreased from 49.93 % to to 2.56 % with increase in plot size from 1 unit to 100 units. Initially the decrease in C.V. % was more rapid but after 20 units plot size the reduction was marginal. These results are in agreement with the results reported by Kumar and Singh (1986), Prajapati *et al.* (1983), Prajapati *et al.* for bidi tobacco (1984), Prajapati *et al.* for mustard (2013), Naliyadara *et al.* (2013) and Patel and Patel for Bajra (1967).

The difference between C.V. % of the consecutive points (plot size) may help to estimate per unit decrease in C.V. % and thereby point of maximum curvature. The results are given in Table 2. The per unit decrease in C.V. % was observed from 15.13 % to 0.06 % with increase in plot size from 2 units to 100 units plot size. Further look into the data clearly indicated that the reduction in C.V. was more rapid in the beginning i.e. up to 20 basic units and then it decreased marginally. Thus, reduction in C.V. was not proportional when plot size increased beyond 20 basic units. The same results graphically presented in Fig. 1 showed the curvature more clearly. Therefore, 20 basic units plot size could be taken as point of maximum curvature (Federer 1955) and appeared to be optimum plot size for field experiments on Isabgul crop.

The correlation among adjacent units was calculated from the data (b=0.8015) using the equation derived by smith (1938). Among different combinations of 20 units plot, a dimension of 4 x 5 showed lowest C.V.%. Hence this size of plot could be considered as optimum plot size (net plot).

Table 2 Per unit decrease in C. V % for seed yield of Isabgul.

Plot size in basic unit	Average C.V. %	Difference in C.V. %	Per unit decrease In C.V. %
1	49.93		
2	34.80	15.13	15.13
4	22.89	11.91	5.96
5	21.86	1.04	1.04
8	16.39	5.47	1.82
10	14.92	1.46	0.73
16	10.94	3.98	0.66
20	**9.87**	**1.07**	**0.27**
25	8.16	1.71	0.34
40	6.09	2.08	0.14
50	5.07	1.02	0.10
80	3.70	1.37	0.05
100	2.56	1.14	0.06

Table 3: Number of replications and area required for 5 per cent S. Em. and relative land use efficiency for seed yield with respect to unit plot size.

No. of basic unit plot size	C.V. %	No. of replications	Area required		Relative land use efficiency (%)
			No. of basic units	Sq. m.	
1	49.93	100	100	90.00	100.00
2	34.80	49	98	88.20	102.04
4	22.89	21	84	75.60	119.05
5	21.86	20	100	90.00	100.00
8	16.39	11	88	79.20	113.64
10	14.92	9	90	81.00	111.11
16	10.94	5	80	72.00	125.00
20	9.87	4	80	72.00	125.00
25	8.16	3	75	67.50	133.33
40	6.09	2	80	72.00	125.00
50	5.07	2	100	90.00	100.00
80	3.70	1	80	72.00	125.00
100	2.56	1	100	90.00	100.00

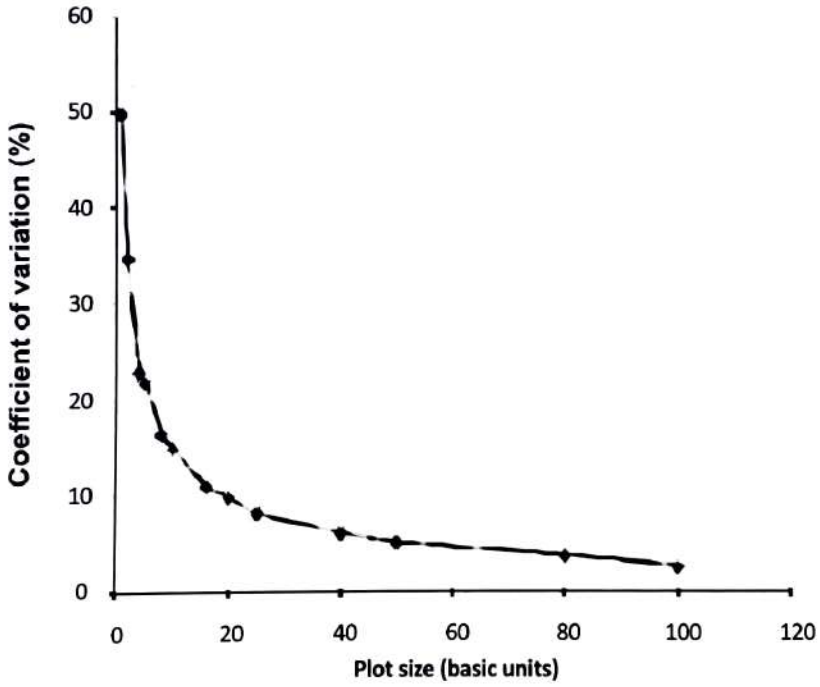


Fig. 1 Coefficient of variation in per cent for different sized plots

The number of replications and required area for different plot size at 5 % standard error of mean were computed from the estimated C.V. % for seed yield of Isabgul by using the formula (Nigam and Gupta, 1979). The results are shown in Table 3. The results (Table 3) revealed that the number of replication decreased and relative land use efficiency increased as the size of plot increased. Agricultural operation in field experiment with smaller plot size, a plot size having relatively high land use efficiency with less number of replications should be considered for field experimentation. Such situation was observed with the 20 units plot size which is having considerably less number of replications and relatively high land use efficiency (Table 3) for seed yield. Therefore, 4 replications could be considered optimum for 20 units plot size at 5 % probability level for Isabgul crop.

CONCLUSION

A plot of 20 basic units size having shape of 12 rows each of 5 meters length (3.6 m x 5 m) was found as optimum plot size (net plot) with 4 replications for field experiments on Isabgul at Agricultural Research Station, S. D. Agricultural University, Kholvada.

REFRENCES

Agrawal, K. N. and Deshpande, M. R. 1967. Size and shape of plots and blocks in field experiments with dibbled paddy. *Indianl Journal of Agricultural Science,* **37** (6) : 445-455.

Federer, W. T. 1955. Experimental design, theory and application. Mac Millan Co., New York 2nd ed., p. 58.

Kumar, P.R. and Singh, N.P. 1986. Analysis of Uniformity trial data with wheat. *Journal of Indian Society of Agricultural Statistics,* **38**(3):310.

Nallyadara, C. M., Patel, D. V. and Upadhyay, S. M. (2013). Uniformity trial on groundnut (*Arachis hypogea* L.). *GAU Research Journal,* **38**(1) : 36-38.

Nigam, A. K. and Gupta, V. K. 1979. *Handbook on Analysis of Agricultural Experiments, 1st edn.,* IASRI Publication, New Delhi, pp.3

Patel, N.M. and Patel R.M.1967. Plot technique in Bajri. B.A.College Magazine. GAU, Anand. p.89-97

Prajapati, B. H., Chaudhary, G. K., Khokhar, A. N., Chaudhary, M. K., and Loria, J. M. 2013. Optimum size and shape of plot for field experiment on of mustard under North Gujarat condition. *GAU Research Journal,* **38**(1) : 32-35.

Prajapati, B. H. and Patel, N. M. 1984. Estimate of optimum plot size uniformity data of bidi tobacco. *GAU Research Journal,* **9**(2) : 36-39.

Singh, H. P. and Singh, D. P. 1989. Optimum plot size for field experiment in mungbean. Narendra Deva, *Journal of Agricultural Research,* **4**(1) : 61-64.

Smith, H. F. 1938. An empirical law describing heterogeneity in the yields of agricultural crops. *Indian Journal of Agricultural Science,* **28** : 1-23.

GAU Research Journal **40** (2) : 113-117 July 2015

Assessment of dietary habits and body mass index of smokers & non smokers

KAVITA GOSWAMI[1], B. G. PATEL[2] AND PREETI DAVE[3]

Department of Food Science & Nutrition,
ASPEE College of Home Science & Nutrition,
S. D. Agricultural University, Sardarkrushinagar-385 506 (Gujarat)

Received : 24 April, 2013

ABSTRACT

Diet and food intake play very important role in maintaining health and well beingness of a person. Even though a person is addicted to smoking, balanced dietary intake and diet rich in antioxidants and vitamins may help in preventing and reducing ill effect of smoking. To assess dietary intake and BMI of smokers and non smokers the present study was undertaken. A ssample of 48 male subjects consist of 24 smokers and 24 non-smokers in the age group of 30 to 35 years were selected for the purposed study. The smokers selected were smoking 18 ± 5 bidis for last 10 to 15 years. Dietary assessment and information regarding general profile of the respondent was collected by questionnaire-cum-interview schedule. BMI of the subjects was also measured. In the study smokers were consuming slightly less amount of total calorie (kcal/day) and significantly less quantity of cereals ($P < 0.05$), green leafy vegetables ($P < 0.05$) and milk and milk products ($P < 0.01$) than non-smokers. Subjects with a total family income of > Rs.10000 were found to have a significantly higher consumption of fruits ($P < 0.01$), meat and eggs ($P < 0.05$). Smokers as a group had significantly lower BMI (Mean ± S.Em) compared to non-smokers (22.49 ± 1.41 vs. 24.81 ± 0.9 kg/ m^2, $P < 0.01$).

Key words : Dietary habits, body mass index, smokers and non smokers

Diet and food intake play very important role in maintaining health and well beingness of a person. Though a person is addicted to smoking, balanced dietary intake and diet rich in antioxidants and vitamins may help in preventing and reducing ill effect of smoking. Vitamin-C is a powerful water-soluble, chain-breaking antioxidant that has several antioxidant effects (Niki, 1987; Jialal *et al.*,1990) and α-tocopherol is suggested to be the most potent antioxidant (Horwitt, 1991). Beta carotenes are lipid soluble antioxidants that are effective scavengers of singlet oxygen, but also of peroxyl radical at low oxygen pressure (Fukuzawa *et al.*, 1998). Flavanoids are occurring naturally in foods and beverages from plant sources such as fruits, vegetables, berries, tea, and wine and there are polyphenolic compounds that provide an important dietary source of antioxidants (Hertog *et al.*, 1992; Hertog *et al.*, 1993 and Kahkonen *et al.*, 2001).

Cigarette smoking is a source of pro-oxidants that promote oxidative stress and contributes to endogenous generation of free radicals via many different mechanisms including the activation of inflammatory cells (Csiszar *et al.*, 2009). Therefore, it has been hypothesized that poor nutritional status may be more pronounced in certain individuals with unhealthy lifestyle behaviors such as smoking (Cade and Margetts, 1991 and Jain *et al.*, 2009). Therefore the present study was attempted to assess dietary intake and BMI of smokers and non smokers.

MATERIALS AND METHODS

A total of 48 male subjects falling in the age group 30 to 35 years were selected for the purposed study out of which 24 each were smokers and 24 non-smokers. The smokers selected were smoking 18 ± 5 bidis for last 10 to 15 years. Information regarding general profile of the respondent was collected by questionnaire-cum-interview schedule.

[1] Nutrition Programme Associate, Surat, [2] Professor, [3] Assistant professor

BMI (Body Mass Index)

BMI was calculated using the formula shown below.

$$BMI = \text{Weight (kg)} / \text{Height}^2 \text{ (M.)}$$

The height of the subjects was measured in centimeter (and converted into meter) using standard scale without footwear. Weight is the simplest measurement of growth and nutritional status and was measured in kilograms using a standard weighing machine with minimum of clothing.

Dietary assessment

Information about diet pattern *i.e.*, type of food, type of non-vegetarian food, skipping meals, oil used and method of preparation were collected. Information about inclusion of main items such as salad, fruits, vegetables and milk product in the diet were also collected with the help of questionnaire. The data collected was subjected to standard statistical procedure to draw valid conclusion.

RESULTS AND DISCUSSION

The data collected on different parameters are presented in table 1 to 5.

Table 1 shows baseline characteristics of subjects taken for the study. It was a group of male subjects of 30-35 years of smokers and non-smokers. The group contains both vegetarians (34) and non-vegetarians (14) and some of them were consuming alcohol. Most of them were illiterate. Total of 33 subjects were found having monthly income, ₹ 5000 In smokers group, majority subject (14) were found BMI in the range of underweight while majority subjects (13) from non-smokers group were found BMI in normal weight range. Smokers were smoking 18±5 cigarates/bidi everyday.

In Table 2 and 3 summary of dietary intake and total calorie intake per day and percentage of total calorie from fat, carbohydrate and protein is summarized.

The average daily food intake (g/day) of smokers and non-smokers is summarized in Table 3. Daily food intake in the form of cereals, pulses and legumes, vegetables and fruits, fats and oils, milk and milk products, meat and eggs and sugar and jaggery was noted using questionnaire method.

Dietary intake of the subjects is depicted in Table 2. In the present study smokers were found to have slightly different food habits as compared to non-smokers. They were also found to consume less quantity of food intake (g/day) particularly a significantly less quantity of cereals, green leafy vegetables and milk and milk products with P values of 0.03, 0.01 and 0.006, respectively. Gujalakshmi *et al.*, (1995) reported the antioxidant vitamins and cardiovascular disease and suggested that higher levels of intake of vitamin E either from dietary, more

Table 1 Baseline characteristics of the subjects

Characteristics	Number of subject
Dietary Habits	
Vegetarian	34
Non-vegetarian	14
Education	
Literate	7
Illiterate	41
General Habits	
Smoking	
Smokers	24
Non-smokers	24
Alcohol Consumption	
Alcoholic	19
Non-alcoholic	29
Exercise	
Daily	3
Weekly	7
Sometimes	11
Sex	
Male smokers	24
Male non-smokers	24
Age group	
30 – 35	48
Total monthly family income groups (₹)	
< 5000	33
5000-10000	12
> 10000	3
BMI groups	
Smokers	
< 20	14
20 – 25	7
> 25	3
Non-smokers	
< 20	6
20 – 25	13
> 25	5
Smoking no. of cigarettes/bidi	
Smokers	18 ± 5
Non-smokers	0

Table 2 Mean food intake (g/day) of smokers and non-smokers

Food groups (g/day)	Smokers (n = 24)	Non-smokers (n = 24)	P value
Cereals	342.13 ± 30.39	352.67 ± 10.39	0.03*
Pulses and legumes	43.09 ± 3.59	47.09 ± 6.56	0.17
Green leafy vegetables	90.31 ± 6.09	96.01 ± 8.89	0.01*
Other vegetables	53.97 ± 8.56	47.64 ± 6.17	0.21
Roots and tubers	62.41 ± 11.34	65.19 ± 7.42	0.39
Fruits	17.12 ± 4.62	11.93 ± 4.31	0.73
Milk and milk products	157.67 ± 23.89	198.18 ± 15.42	0.006*
Meat and eggs	9.35 ± 6.23	6.11 ± 4.27	0.34
Fats and oils	38.56 ± 8.75	37 ± 11.01	0.53
Sugar and jiggery	46.71 ± 7.90	43.17 ± 9.53	0.41

*Significant at P < 0.05; Values are represented as Mean ± S.Em

Table 3 Total calorie intake of the selected subjects

Subjects	Total kcal/Day	Percentage of kcal from fat	Percentage of kcal from carbohydrates	Percentage of kcal from proteins
Smokers	2310 ± 73	38.2 ± 1.2	55.1 ± 1.5	9.2 ± 2.7
Non-smokers	2372 ± 87	37.6 ± 1.8	50.2 ± 2.1	11.2 ± 1.0

Values are represented as Mean ± S.Em.

likely, from vitamin supplementation that are sustained for two or more years are associated with a reduced risk for fatal and non-fatal cardiovascular disease.

It was observed that both smokers and non-smokers were used to take almost similar caloric intake. For both smokers and non-smokers, the major sources of calorie was carbohydrate, followed by fat and proteine.

Socio-economic condition and nutritional status

All the subjects were categorized in three groups depending upon the total family income per month *i.e.,* family income group-1 (> ₹ 10000, n = 3); family income group-2 (< ₹ 5000, n = 33). Subject group with a total family income of > ₹ 10000 was found to have a significantly higher consumption of fruits, meat and eggs as compared to other two groups (Table 4).

Table 4 Food consumption of different family income groups

Food groups (g/day)	Family income group1 (n = 3)	Family income group2 (n = 33)	P value
Fruits	38.12 ± 13.62	16.93 ± 7.35	0.009*
Meat and eggs	30.35 ± 8.14	16.11 ± 11.23	0.017*

Family income Group1 (n = 3) - Total family income > ₹ 10000 per month, Family income group 2 (n = 33) - Total family income < ₹ 5000 per month, Values are represented as Mean ± S.Em, Two-sample t-test, * Significant at P < 0.05.

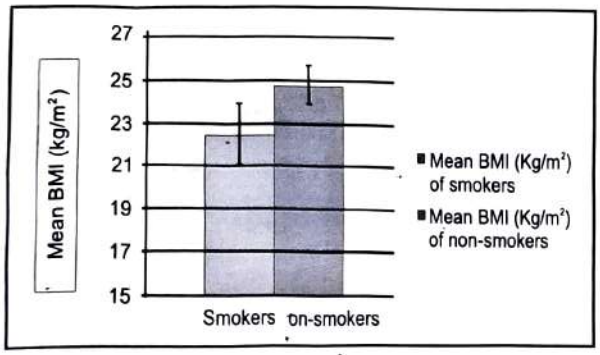
Mean body mass index (BMI) was found significantly lower in smokers group as compared to non-smokers (Fig. 1). Smokers as a group had significantly lower BMI (Mean ± S.Em) compared to non-smokers (22.49 ± 1.41 vs. 24.81 ± 0.9 kg/m², P < 0.01 (Table 5).

Table 5. Comparison between mean BMI of smokers and non-smokers

	Smokers (n = 24)	Non-smokers (n = 24)	P value
Mean BMI (kg/m²)	22.49 ± 1.41	24.81 ± 0.9	0.007*

Two-sample t - test; * Significant at P < 0.05.

Fig 1 Comparison of mean BMI of selected smokers and non-smokers



Values are represented as mean ± S.Em. n = 24 for both smokers and non-smokers

Pryor and Stone (1993) and Jens *et al.*, (2000) reported that smokers and non-smokers supplemented with multi-vitamins for three months showed an increase of 194 per cent of blood plasma vitamin C level in smokers and 43 per cent in non-smokers, suggesting that vitamin C supplementation had more effect in smokers than in non-smokers.

Betts *et al.* (2000) correlated the smoking with dietary habits and found that smokers were differing from non-smokers in quantity intake, type of food consumed and dietary pattern. The same trend was found in present study and validates earlier reports.

Sneve and Jorde (2008) and many other researchers showed a significantly lower Body Mass Index (BMI) in smokers as compared to non-smokers. Lower BMI in smokers may be due to eating disorders caused by smoking. Doris *et al.* (2006) in their study correlated the eating disorders with smoking.

CONCLUSION

Smokers were consuming slightly less amount of total calorie (kcal/day) and significantly less quantity of cereals (P < 0.05), green leafy vegetables (P < 0.05) and milk and milk products (P < 0.01) than non-smokers. Subjects with a total family income of > Rs.10000 were found to have a significantly higher consumption of fruits (P < 0.01), meat and eggs (P < 0.05). Smokers as a group had significantly lower BMI (Mean ± S.Em) compared to non-smokers (22.49 ± 1.41 vs. 24.81 ± 0.9 kg/m², P < 0.01).

REFERENCES

Betts Nancy, M., Jun, Ma and Jeffrey, S. Hampl. 2000. Antioxidant intakes and smoking status : data from the continuing survey of Food Intakes by Individuals. 1994-1996. *The American Journal of Clinical Nutrition*, **71** : 774-780.

Cade J. E. Margetts, B. M. 1991. Relationship between diet and smoking–is the diet of smokers different? *Journal of Epidemiology and Community Health*, **45**(4):270–272.

Csiszar A, Podlutsky A, Wolin MS, Losonczy G, Pacher P, Ungvari Z., 2009. Oxidative stress and accelerated vascular aging: implications for cigarette smoking. Front Bioscience, **14:3** 128-3144.

Doris, A. Kelly, L. Klump. Laura, Thornton. Harry Brandt. Steve Crawford. Manfred, M. Fichter. Katherine, A. Halmi. Craig, Johnson, Allan, S. Kaplan. Maria, LaVia, James, Mitchell. Michael Strober, D. Blake Woodside. Alessandro Rotondo. Wade, H. B. Walter, H. J. and Cynthia, M. B. 2006. Smoking in eating disorders. *Eating Behaviours.* **7** : 291-299.

Fukuzawa, K. Inokami, Y. Tokumura, A. Terao, J. and Suzuki, A. 1998. Rate constants for quenching singlet oxygen and activities for inhibiting lipid peroxidation of carotenoids and alpha-toxopherol in liposomes. *Lipids.* **33** : 751-756.

Gajalakshmi, C. K. Jha, P. and Ranon, K. 2000. Global patterns of smoking and smoking-attributes mortality. In : Jha, P.; Chaloupka, F. Eds. Tobacco control in developing countries. New York. Oxford University Press. pp. 11-39.

Hertog, M. G. Hollman, P. C. and Katan, M. B. 1992. Content of potentially anticarcinogenic flavonoids of 28 vegetables and 9 fruits

commonly consumer in the Netherlands. *Journal of Agricultural Food Chemistry,* **40** : 2379-2383.

Hertog, M. G. Hollman, P. C. and Van den Putte, B. 1993. Content of potentially anticarcinogenic flavonoids of tea infusions, wines and fruit juices. *Journal of Agricultural Food and Chemistry,* **41**: 1242-1246.

Horwitt, M. K. 1991. Data supporting supplementation of humans with vitamin E. *Journal of Nutrition,* **121** : 424-429.

Jain A, Agrawal B. K. Varma, M. Jadhav, A. A. 2009. Antioxidant status and smoking habits: relationship with diet. *Singapore Medical Journal*, **50**(6):624–627.

Jens, L. Stephan, C. Lynn, M. W. Hurry, H. C. and Bruee, N. A., 2000. Ascorbate is depleted by smoking and repleted by moderate supplementation : a study in male smokers and non-smokers with matched dietary antioxidant intakes. *The American Journal of Clinical Nutrition,* **71** : 530-536.

Jialal, I. Vega, G. L. and Grundy, S.M. 1990. Physiologic levels of ascorbate inhibit the oxidative modification of low density lipoprotein. *Atherosclerosis.* **82** : 185-191.

Kahkonen, M. P. Hopia, A. and Heineman, M. 2001. Berry phenolics and their antioxidant activity. *Journal of Agricultural Food and Chemistry,* **49** : 4076-4082.

Niki, E. 1987. Antioxidants in relation to lipid peroxidation. *Chemistry and Physics of Lipids,* **44** : 227-253.

Pryor, W. A. and Stone, K. 1993. Oxidants in cigarette smoke. *Annals of New York Academic of Science,* **686** : 12-27.

Sneve, M. and Jorde, R., 2008. Cross-sectional study on the relationship between body mass index and smoking and longitudinal changes in body mass index in relation to change in smoking status : The Tromso Study *Scandinavian Journal of Public Health,* **36** (4) : 397-408.

GAU Research Journal **40** (2) : 118-120 July 2015

Short Communication

Studies on induced mutagenesis in grain amaranth [*Amaranthus hypochondriacus.* (L.)]

S.D. SOLANKI[1], T. A. DESAI[2] AND N. N. PRAJAPATI[3]

Department of Genetics and Plant Breeding,
C.P. College of Agriculture,
S. D. Agricultural University Sardarkrushinagar-385 506 (Gujarat)

Received : 29 October, 2014

Amaranth is an underutilized psudocereal crop belonging to family Amaranthusaceae (Dicotyledons, Order-Caryophyllales). The genus Amaranthus includes other species of grain type Amaranth *viz.*, Amaranthus hypochondriacus L. (2n=32), A. cruentus L. (2n=34), A. caudatus L. (2n=32 and occasionally 2n=34 also), A. adulis Spegazzini (2n=32) and A. tricolor (2n=34).

The grain amaranth is thought to be of American origin. Grain amaranthus (Amaranthus spp.) is offering lot of potentiality to be explored as future food crop by virtue of its high quality protein rich grain and carotene rich leaves. The grain has high protein with high lysine content and good source of other essential amino acids.

Hybridization is difficult in grain amaranth due to small flower structure, hence, mutation breeding is a better way to create variability. Mutation induced in self-pollinated crops, is of great value in plant breeding and is recognized as a potential tool for crop improvement by way of creating variability in the population (Hagberg et.al .1963). Mutagenesis is as effective as hybridization in supplying the genetic variability for selection (Virupakashappa *et al.*1980).

Pure, healthy and mature seeds of the two varieties of amaranth (Gujarat amaranth-1 and Gujarat amaranth-2) were exposed to different doses of gamma rays at Bhabha Atomic Research Centre (BARC), Trombay with gamma rays intensity of 18 Gy per minute. The doses were given *viz.*, 0, 50, 100, 150, 200, and 250 Grey to both the varieties.

For chemical treatments, the solution of ethylmethane sulphonate (0.1, 0.2, 0.3, 0.4, 0.5 %) and sodium azide (0.01, 0.02, 0.03, 0.04, 0.05 %) were prepared in phosphate buffer at pH 7.0. 50 gm dry seeds pre-soaked in distilled water for 2 hours before they were treated with chemical mutagens for each treatment. Pre-soaked seeds were treated with freshly prepared solutions of chemicals mutagen ethylmethane sulphonate (EMS) for 4 hours and sodium azide for 6 hours at room temperature.

In M_2 generation data were recorded on the following quantitative and qualitative characters viz., days to flowering, days to maturity, plant height (cm), length of inflorescence (cm), seed yield per plant (g), test weight (g), protein content (%), ash content (%), oil content (%) and harvest index (%).

Effect of physical and chemical mutagens are presented in table 1, 2 and 3. Both the varieties exhibited variation due to mutagenic treatments. The mean values were shifted towards positive and negative directions depending on the characters and doses of various mutagens in M_2 generation. For plant height, mean was shifted in negative direction at different doses of gamma rays, EMS and SA, while in the shift was in positive direction at 150 Gy. gamma rays in GA-1 and at 200 Gy. gamma rays as well as 0.2 per cent EMS in GA-2.

For days to flowering and maturity, shift of mean in negative direction was observed in all the mutagens, which is most desirable for developing an early maturity variety. For length of inflorescence, seed yield, test weight, protein content and harvest index, shift of mean was observed towards negative direction in all the mutagenic treatments. The oil content showed positive as well as negative direction of shift in mean. For ash content, shift of the mean was in positive direction in all the treatments, except 0.4 per cent EMS in GA-2. Sree Ramula (1974) reported that increase in mean values of quantitative depended on the mutagenic treatments and the frequency distribution for various quantitative traits showed that incidence of polygenic

[1] Associate Proffesor, [2] P. G. student, [3]Assistant Research Scientist, Centre for Crop Improvement

Table 1 Effect of gamma rays on mean values of quantitative and qualitative characters in M_2 generation of two varieties GA-1 and GA-2.

Characters	Gujarat amaranth-1						Gujarat amaranth-2					
	0 Gy.	50 Gy.	100 Gy.	150 Gy.	200 Gy.	250 Gy.	0 Gy.	50 Gy.	100 Gy.	150 Gy.	200 Gy.	250 Gy.
Days to flowering	58.04	56.44	56.24	57.00	55.28	54.04	49.05	48.61	48.36	48.19	48.91	46.19
Days to maturity	117.30	116.30	115.40	116.80	114.90	113.00	109.50	107.90	107.90	106.60	108.10	104.10
Plant height (cm)	178.50	177.10	176.00	178.90	174.40	171.40	174.90	173.50	171.30	169.50	175.90	167.80
Length of inflorescence (cm)	83.85	82.65	82.45	83.28	81.73	80.65	87.91	87.31	85.87	85.04	85.93	84.76
Yield per plant (g)	22.63	21.46	19.15	21.40	17.09	16.37	25.91	24.26	24.21	23.79	24.98	20.84
Test weight (g)	0.92	0.92	0.91	0.92	0.90	0.88	0.96	0.96	0.96	0.93	0.95	0.94
Protein content (%)	15.90	15.50	15.59	15.50	15.69	15.24	15.69	15.44	15.33	15.54	15.58	15.29
Ash content (%)	8.42	8.51	8.57	8.48	8.55	8.53	8.40	8.54	8.58	8.59	8.44	8.50
Oil content (%)	4.63	4.60	4.56	4.66	4.47	4.69	4.69	4.63	4.59	4.71	4.40	4.51
Harvest index (%)	23.65	23.47	22.64	23.04	22.32	20.46	26.15	25.14	24.91	23.99	25.27	21.45

Table 2 Effect of EMS on mean values of different characters in M_2 generation of two varieties GA-1 and GA-2.

Characters	Gujarat amaranth-1						Gujarat amaranth-2					
	0 %	0.1 %	0.2 %	0.3 %	0.4 %	0.5 %	0 %	0.1 %	0.2 %	0.3 %	0.4 %	0.5 %
Days to flowering	58.04	55.81	55.32	56.12	53.49	53.00	49.05	46.20	48.87	46.11	45.73	43.92
Days to maturity	117.30	115.90	114.00	114.00	113.00	112.20	109.50	104.80	106.00	104.80	103.90	102.40
Plant height (cm)	178.50	177.70	175.10	176.20	173.50	168.90	174.90	172.90	175.20	168.10	165.10	162.80
Length of inflorescence (cm)	83.85	81.31	81.37	82.71	79.82	78.74	87.91	86.47	86.09	86.18	84.25	82.52
Yield per plant (g)	22.63	19.80	17.42	18.22	16.87	16.40	25.91	24.14	25.31	21.46	21.34	18.97
Test weight (g)	0.92	0.91	0.88	0.90	0.89	0.86	0.96	0.95	0.94	0.95	0.94	0.92
Protein content (%)	15.90	15.66	15.74	15.35	15.74	15.25	15.69	15.52	15.46	15.42	15.54	15.31
Ash content (%)	8.42	8.68	8.62	8.55	8.53	8.60	8.40	8.43	8.62	8.60	8.29	8.63
Oil content (%)	4.63	4.48	4.55	4.44	4.41	4.70	4.69	4.39	4.36	4.67	4.28	4.59
Harvest index (%)	23.65	22.92	22.21	22.51	20.04	18.73	26.15	23.41	24.68	22.22	22.14	20.27

variation in the positive and negative directions was nearly equal following mutagenic treatments. Selection of normal looking plants from the M_2 was effective in increasing the genetic variability in the population as compared with the untreated population. The decrease in mean value in the mutagen treated population has already been demonstrated by many workers in wheat Bhatia and Swaminathan (1962); Dhonukshe and Bhowal (1976), in sorghum Sree Ramulu (1974); Reddy and Cheralu (1984), in Vigna Borah and Khan (1998) and in Greengram, Sarma and Talukdar (1999).

All the treatments induced variation in mean in negative direction for most of characters, while in some characters mean values were in positive direction. Only plant height and oil content were influenced by some treatments and showed positive direction in mean value. For ash content, all the treatments showed positive direction in mean value. For plant height mean in negative direction is useful in breeding programme to develop dwarf varieties which have lodging resistant capacity. For days to flowering and maturity, shift of mean in negative direction are useful in breeding programme for developing an early mature varieties.

Table 3 Effect of SA on mean values of characters in M_2 generation of two varieties GA-1 and GA-2.

Characters	Gujarat amaranth-1						Gujarat amaranth-2					
	0 %	0.01 %	0.02 %	0.03 %	0.04 %	0.05 %	0 %	0.01 %	0.02 %	0.03 %	0.04 %	0.05 %
Days to flowering	58.04	56.11	56.07	56.27	55.00	54.17	49.05	46.72	46.12	45.45	46.19	44.23
Days to maturity	117.30	116.00	115.10	115.90	113.30	113.10	109.50	106.20	105.40	103.80	103.90	102.10
Plant height (cm)	178.50	177.60	176.40	177.40	175.70	167.70	174.90	172.50	170.60	169.20	170.00	164.80
Length of inflorescence (cm)	83.85	82.43	82.20	81.69	80.98	80.56	87.91	86.79	84.41	85.27	83.22	82.46
Yield per plant (g)	22.63	20.42	19.49	19.83	16.05	16.25	25.91	23.04	22.54	20.69	21.85	19.36
Test weight (g)	0.92	0.91	0.92	0.91	0.88	0.88	0.96	0.96	0.95	0.95	0.95	0.94
Protein content (%)	15.90	15.72	15.60	15.47	15.35	15.40	15.69	15.48	15.43	15.16	15.50	15.46
Ash content (%)	8.42	8.51	8.53	8.59	8.51	8.60	8.40	8.62	8.65	8.57	8.49	8.64
Oil content (%)	4.63	4.50	4.43	4.42	4.62	4.46	4.69	4.61	4.33	4.54	4.37	4.45
Harvest index (%)	23.65	23.30	22.25	22.29	20.46	20.11	26.15	24.56	24.29	21.55	22.69	20.40

REFERENCES

Bhatia, S. and Swaminathan, M. S. 1962. Induced polygenic veriability in bread wheat and its bearing on selection procedures.*Z. Pflanzenfuecht.* **48**: 317-26.

Borah, H. K. and Fazlullah Khan, A. K. 1998. Effect of seed irradiation on some plant characteristics of *Vigna marina* Merr. and Siratro (*Macroptiliumatropureum* (DC) urb.). *Madras Agricultural Journal*, **85** (10-12) : 608-611.

Dhonukshe, B. L. and Bhowal, J. G. 1976. Radiation induced polygenic variation in dwarf wheat. *Indian Journal of Genetics,* **36** : 1-5.

Hagberg, A, Person, G. and Wiberg, A. 1963. Induced mutation in the improvement of self pollinated crops. In : Recent Plant breeding Research. Eds. E. Aokerberg; A. Hagberg, G. Olsson, O. Tedin, John wiley and Sons, New York, PP. 105-124.

Reddy, C. S. and Cheralu, C. 1984. Induced quantitative variability in Indian and American sorghums. *Sorghum Newsletter,* **5**:88.

Sarma, A. and Talukdar, P. 1999. Sensitivity of green gram [*Vigna radiata* (L.)Wilczek] to physical and chemical mutagens. *Journal of International academician.* **3** (1) : 11-18.

Sree Ramulu, K. 1974. Induced polygenic variability in sorghum. *Genetica Agraria.* 28 : 278-291.

Virupakashappa, K., Mashishi, D. M. and Shivashankar, G. 1980. Variation In cowpea fallowing hybridization and mutagenesis. *Indian Journal of Genetics* **40** : 396-398.