# GUJARAT AGRICULTURAL UNIVERSITY

# RESEARCH JOURNAL



VOLUME : 15 : NUMBER : 2 JANUARY, 1990

GAU RES. J. 15 (2)

# SUGGESTIONS FOR CONTRIBUTORS

Gujarat Agricultural University Research Journal is published biannually, in January and July.

## General Requirements :

Articles must be original reports of research in agricultural science, comprising Agriculture, Dairy, Animal Husbandry and Veterinary, Agricultural Engineering, Home Economics, Basic Sciences and Humanities Forestry, Fisheries etc , not previously or simultaneously published in any other scientific or technical journal. The papers are to be submitted in duplicate inclusive of illustrations They must be concise and not unnecessarily elaboarate. Papers are accepted subject to the right of minor editorial revision if considered necessary. No reasons will be given in cases of non-acceptance of the articles.

Articles will be accepted only from the author who is the subscriber of the journal.

## Short Communication :

Short communication should include title of communication followed by the names of authors and department of origin. The reporting matter shall be a continuous report with minimum references and it may not exceed two to three typed foolscaps.

## Manuscript :

The manuscript must be typed, in double space on standard typewriter with pica lettering on one side of 32 cm x 20 cm paper with 4 cm margin The lines of type must be numbered on each page in the margin. No overwriting is admissible.

Title page should be separate and have the following title of paper, authors department of origin, complete address for mailing and a suggested running title not exceeding 40 letters.

Text should have the following sub-divisions : Abstract-not exceeding 125 words in the beginning, Introduction, Materials and Methods, Results and Discussion may then follow. The introduction should not be very elaborate.

Tables should be numbered consecutively and typed on separate sheets. The tables should be designed in a manner to fit 14 cm x 19 cm space on printing. Matter which is presented in charts and graphs should not be duplicated.

Footnotes should be numbered consecutively and typed at the bottom of the pages. The symbols to be used for indicating footnotes will be : *, †, §, **, ‡ etc.

## Illustrations and Figures :

Photographs for halftone production should be glossy prints with good dark and light contrast Line drawings and graphs should be prepared in India ink on thick white paper of at least twice the size of final reproduction. Each illustration should carry the title of the paper the number of the figure on its reverse. They are to be numbered in Arabic numerals. Legends to individual figures or graphs should be given on separate sheet

Ahme
Dr. K.

# Gujarat Agricultural University Research Journal

January, 1990
Vol. 15, No. 2





**Editorial Office :**

Publication Unit,
Gujarat Agricultural University,
Shahibag, Dafnala,
**Ahmedabad-380 004.**
INDIA.


## CONTENTS



### Short Communications

## Abstracts of Ph.D. Thesis

# FORM IV

*(See Rule 8)*

| | | | |
|---|---|---|---|
| 1. | Place of Publication | : | Publication Unit,<br>Gujarat Agricultural University,<br>Shahibag, Near Dafnala,<br>Ahmedabad-380 004. |
| 2. | Periodicity of its publication | : | Biannual |
| 3. | Printer's Name | : | Shri Indra Patel |
| | whether citizen of India ? | : | No. |
| | (If foreigner, state the country of origin) | : | BOC |
| | Address | : | Shital Process Studio<br>KDCC Bank Bldg., Mahatma Gandhi Marg<br>ANAND 388 001.<br>Phones : (02692) 22331 & 22538. |
| 4. | Publisher's Name | : | Dr. D. N. Pandya<br>Director of Extension Education,<br>Gujarat Agricultural University. |
| | Whether citizen of India | : | Yes |
| | (If foreigner, state the country of origin) | : | Gujarat Agricultural University,<br>Govt. Bunglow No. 6, Near Dafnala,<br>Shahibag, Ahmedabad-380 004. |
| 5. | Editor's Name | : | Dr. K. Janakiraman,<br>Chairman, Editorial Board |
| | Whether citizen of India? | : | Yes |
| | (If foreigner, state the country of origin) | | |
| | Address | : | Gujarat Agricultural University,<br>Govt. Bunglow No. 5, Near Dafnala,<br>Shahibag, Ahmedabad-380 004. |
| 6. | Names and addresses of individuals who own the newspaper and partners or shareholders holding more than one per cent of the total capital. | : | Dr. D. N. Pandya on behalf of the<br>Gujarat Agricultural University,<br>Govt. Bunglow No.6,<br>Near Dafnala, Shahibag,<br>Ahmedabad-380 004. |

I, Dr. D.N. Pandya hereby declare that the particulars given above are true to the best of my knowledge and belief.

Dated : 30th January, 1990

D. N. Pandya
Signature of Publisher

GAU Res. J. 1990. 15 (2) : (1-5)

# Effect of Nitrogen and Phosphorus Levels on Growth and Yield of Onion (*Allium cepa* L.) Cultivar Pusa Red

J. J. Patel and A. T. Patel

Regional Research Station, Gujarat Agricultural University, Sardar Krushinagar

## ABSTRACT

A Field experiment was laid out in rabi seasons of three years (1979-81) with a view to find out t optimum dose of nitrogen and phosphorus for obtaining maximum yield of onion bulbs. The treatme combinations comprised of five levels of nitrogen (0, 30, 60, 90 and 120 kg/ha) and three of phosphor (0,30 and 60 kg/ha) were evaluated in randomised block design replicated four times in all seasons. T results revealed that the differences in yield of bulbs due to levels of nitrogen were found to be significar However, it remained unaffected by varying levels of phosphorus. The nitrogen dose of 100 kg/ha w found to be the optimum for securing high yield of onion bulb per hectare.

*(Received on 17th March, 198*

## INTRODUCTION

Essentially onion occupies a unique position in medical prescriptions, being used for curing of number of diseases like cough, jaundice, phytoncides etc. Onion as an essential oil which is used in killing bacteria and protozoa. Highly pungent types of onion are used for manufacturing the savce, canned soups etc.

Onion is an important vegetable crop grown throughout India in all types of soils. Many research workers have reported that the actual amount and the type of fertilizers required depend upon soil type, climate and also variety of the crop. An onion yielding 100 quintals per hectare removes about 30 kg of nitrogen from the soil. Roy and Chaudhary (1950) suggested an application of 40 kg N/ha when gave the best results in respect of yield of cauliflower. Raza and Shaikh (1972) observed that the onion required 60 kg N/ha for getting higher yield of bulbs/ha. The experiments conducted by Rahman *et al.* (1978) and Balasundaram *et al.* (1983) at various places indicated that the higher onion bulbs production was associated with nitrogen and potash applications. The moderate response was obtained by the application of phosphorus (Balasundaram *et al.*, 1983).

## MATERIALS AND METHODS

The field experiments were conducted in san loam soil at the Vegetable Research Farm, Gujar Agricultural University, Sardar Krushinagar duri rabi seasons of the years 1979 to 1981 to evalua 15 combinations comprising of five levels nitrogen (0, 30, 60, 90 and 120 kg N/ha) and thr levels of phosphorus (0, 30 and 60 kg $P_2O_5$/h Site was changed every year. The fertility status the experimental site during each year in respect available nitrogen was 260.0, 225.5 and 275 kg/ha during 1979-80, 1980-81 and 1981-82 yea respectively while available phosphorus was 52. 58.4 and 67.5 kg/ha and available potassium w 369.5, 336.0 and 322.6 kg/ha respectively. Tl trial was laid out in a randomised block design wit four replications. The net plot size was 4.32 m Four week old seedlings were transplanted at 15 c × 15 cm spacing. The entire quantity of $P_2O_5$ an half the dose of N were applied as a basal dressing i the form of superphosphate (single) and amoniu sulphate respectively. Remaining half the quantit of nitrogen was given 45 days after transplanting i the form of urea. Ten plants were tagged in eac treatment plot for recording the ancillar observation. The crop in all received 10, 12 and 1 waterings in the years 1979, 1980 and 1981 in rab

on, respectively. The bulbs of onion variety
red from net plots were dug out, dried in the
for 21 days and weighed. The data were
ected to statistical analysis as per Panse and
natme (1967).

## RESULTS AND DISCUSSION

The bulb yield data (Table-1) indicated
eased yield with increase in dose of nitrogen
n 0 to 90 kg/ha. The differences in yield of
os due to nitrogen levels were found to be
ificant in all the three years as well as in pooled
lts.

The maximum bulb yield of 294.9 q/ha was
ained with 90 kg N/ha which was significantly
erior to rest of the levels. These results are in
eement with those reported by Rahman *et al.*
78) and Balasundaram *et al.* (1983). There was
difference in yield between 90 and 120 kg N/ha.
e response of nitrogen was guardratic and was
best fitted to curves (Fig.1) defined by equations as indicated below :

$$Y = a + bx + cx^2$$
$$= 128.89 + 3.11\ x + -0.015X^2$$

Where Y = Expected yield in q/ha at X unit of nitrogen

X = Unit of nitrogen (one unit = one kg of nitrogen)

The computed (pooled data) economic optimum dose of nitrogen was 100.13 kg/ha with corresponding onion bulb yield of 297.11 q/ha.

The results further revealed that the differences in yield of onion bulbs were not found to be significant due to levels of phosphorus in all the years of investigation as well as in pooled data also. The non-significant effect of P fertilization is attributed to medium to high status of the soil for available phosphorus.

An interaction (N × P) was found to be non-significant in individual year as well as in pooled analysis (Table 2).

*BLE 1*

**fect of nitrogen and phosphorus levels on yield (q/ha) of onion bulbs.**

| *reatments* | *Year* | | | *Mean* |
|---|---|---|---|---|
| | *1979* | *1980* | *1981* | |
| $N_0$ | 80.44 | 42.64 | 267.59 | 130.22 |
| $N_{30}$ | 121.13 | 75.82 | 424.68 | 207.21 |
| $N_{60}$ | 127.51 | 126.84 | 534.88 | 263.08 |
| $N_{90}$ | 138.31 | 162.01 | 583.41 | 294.88 |
| $N_{120}$ | 130.78 | 206.41 | 535.88 | 291.09 |
| S. Em. | 19.10 | 19.68 | 47.43 | 8.08 |
| C.D. at 5% | 54.70 | 56.69 | 135.42 | 22.62 |
| $P_0$ | 114.69 | 127.37 | 455.51 | 232.53 |
| $P_{30}$ | 115.91 | 122.98 | 493.21 | 237.37 |
| $P_{60}$ | 128.30 | 118.41 | 479.75 | 242.99 |
| S. Em. | 14.90 | 15.28 | 36.81 | 6.26 |
| C.D. at 5% | N.S. | N.S. | N.S. | N.S. |

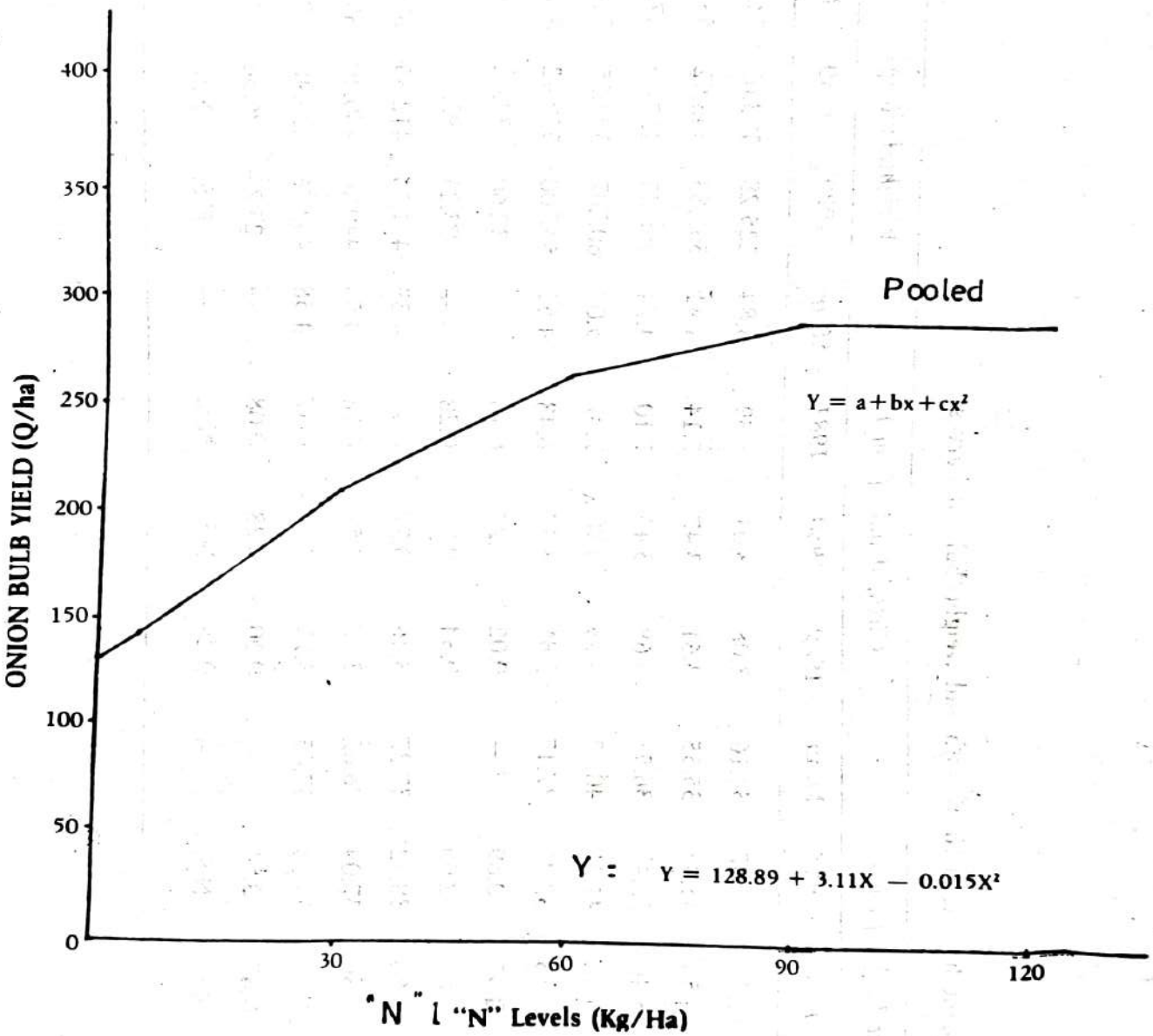


**Fig. 1. Response of N on onion bulb yield**

TABLE 2

**Effect of N and P levels on plant height, girth of bulb and weight/bulb at harvest.**

| Treatments | Plant height ( cm ) | | | | Girth of bulb ( cm ) | | | | Weight/bulb (g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | Mean | 1979 | 1980 | 1981 | Mean | 1979 | 1980 | 1981 | Mean |
| $N_0$ | 34.50 | 32.93 | 35.07 | 34.16 | 3.08 | 3.04 | 3.39 | 3.84 | 225.28 | 173.67 | 340.00 | 246.31 |
| $N_{30}$ | 36.35 | 34.53 | 35.87 | 35.55 | 3.61 | 3.47 | 6.14 | 4.41 | 363.83 | 346.92 | 539.58 | 416.78 |
| $N_{60}$ | 36.05 | 35.40 | 37.47 | 36.51 | 3.69 | 3.43 | 7.10 | 4.74 | 596.83 | 477.00 | 676.58 | 553.47 |
| $N_{90}$ | 40.84 | 39.40 | 41.33 | 40.52 | 3.93 | 3.90 | 7.37 | 5.07 | 607.07 | 593.75 | 741.25 | 647.36 |
| $N_{120}$ | 38.70 | 35.53 | 37.27 | 37.17 | 3.81 | 3.37 | 6.48 | 4.55 | 537.00 | 520.42 | 680.83 | 579.42 |
| S. Em. | 1.06 | 0.57 | 0.69 | — | 0.02 | 0.29 | 0.10 | — | 32.60 | 34.06 | 69.29 | — |
| C D at 5% | 3.03 | 1.63 | 2.00 | — | 0.34 | 0.83 | 0.28 | — | 93.25 | 97.43 | 172.21 | — |
| $P_0$ | 37.98 | 35.80 | 38.32 | 37.37 | 3.46 | 3.27 | 6.45 | 4.39 | 451.35 | 412.35 | 678.35 | 514.15 |
| $P_{30}$ | 37.45 | 35.36 | 37.04 | 36.62 | 3.67 | 3.54 | 6.56 | 4.59 | 440.40 | 430.30 | 691.25 | 520.65 |
| $P_{60}$ | 37.78 | 35.12 | 38.24 | 37.05 | 3.75 | 3.51 | 6.47 | 4.58 | 452.26 | 424.40 | 608.75 | 495.14 |
| S. Em. | 0.82 | 0.67 | 0.54 | — | 0.10 | 0.28 | 0.08 | — | 25.25 | 26.38 | 46.70 | — |
| C D at 5% | N.S. | N.S. | N.S. | — | 0.28 | N.S. | N.S. | — | N.S. | N.S. | N.S. | — |

As regard to height of plant, girth of bulb and weight per bulb (Table 2), it was observed that the differences in all these characters were significant due to graded doses of nitrogen during all the three years of the investigation.

There was increase in all the characters with the increase in level of nitrogen from 0 to 90 kg/ha. The similar trend was observed in pooled mean also. An application of nitrogen above 90 kg/ha did not appear to be beneficial in enhancing the yield of bulb/ha.

The effect of phosphorus levels was found to be non-significant in all the three years in respect of plant height and weight/bulb (Table 2) while, significant differences were observed in girth of bulb only in the year 1979 indicating significant superiority of 60 kg $P_2O_5$/ha over that of no application (PO).

Effect of interaction N × P was not found to be significant on all these characters in any year of experimentation.

## REFERENCES


Balasundram, O. S., A. Ramakrishnan, C. Kailasam and C. Paulraj (1983). Optimizing fertilizer rates for bellary onion. *Indian J. Agric. Sci.*, **53** : 1022-25.

Rahman, S., M. R. Talukdar and A. H. Miah (1978). Effect of Nitrogen, Phosphorus and Potash on the bulb size and yield of onion. *Fide Hort. Abstr.* **48** : 481 (Abstr. No. 5439).

Reza, S. H. and Z. U. D. D. Shaikh (1972). Optimum dose of N. P. K. Fertilizer for maximum production of onion. *Hort. Abstr.* **43** : 515 (Abstr. No. 617).

Roy, R. S. and B. Chaudhary (1950). Effect of fertilizers on the yield of cauliflower. *Indian J. Hort.* **8** : 70 : 72.

Panse, V. G. and P. V. Sukhatme (1967). Statistical Methods for Research Workers. I. C. A. R. New Delhi.

AU Res. J. 1990. 15 (2) : 6-11

# Effect of Seed Rate and Phosphorus Levels on the Seed Production of Lucerne Var. A-2 Under Different Dates of Sowing

J. R. Patel, A. T. Patel, P. C. Patel and B. B. Patel

A. I. C. R. P. on Forage Crops, GAU, Anand Campus, Anand

## ABSTRACT

An experiment was conducted on lucerne for three years at Sardar Krushinagar to study the effect of seed rates and phosphorus levels on the seed production of lucerne var. A-2 under different dates of sowing. The results revealed that in lucerne early sowing date (last week of October) obtained higher seed yield than other delayed sowing dates. Similar was the case for green forage and dry matter yields. Last week of October indicated the highest total returns and Net Incremental Cost Benefit Ratio (NICBR). Seed rate of 5 kg seed/ha gave higher seed yield of lucerne seed but for forage production, a seed rate of 10 kg/ha was found significantly superior than that of lower seed rate of 5.0 and 7.5 kg/ha. Relative profitability of different seed rates of lucerne showed that higher total returns were obtained when the seed rate of lucerne was used at the rate of 10 kg seed/ha. Application of phosphorus to lucerne crop failed to increase significant seed yield of lucerne. Application of 80 kg $P_2O_5$/ha produced significantly higher green forage and dry matter yields and this level showed higher total returns and NICBR. The interaction of sowing of lucerne on last week of October x application of 80 kg $P_2O_5$/ha produced significantly higher seed yield and forage yields of lucerne as well as highest net returns and NICBR.

*(Received on 18th March, 1988)*

## INTRODUCTION

Lucerne crop is more popular among farmers in Gujarat during winter season. It is also a important forage crop in milkshed area where the livestock production is involved. In any seed production programme, seeds and fertilizers are the major costly inputs, so their proper utilization is a must. Sowing date is non-monetory input, however, appropriate time of sowing significantly increases the forage yield. In absence of preliminary information regarding the seed rate requirement, sowing date and phosphorus requirement for the production of lucerne seeds in the North Gujarat condition, this investigation was carried out at Sardar Krushinagar to study the effect of seed rates and phosphorus levels on the seed production of lucerne (Anand-2) sown on different dates.

## MATERIALS AND METHODS

A field experiment was conducted at Forage Research Project Farm, Gujarat Agricultural University, Sardar Krushinagar during three consecutive *Rabi* season of 1984-85, 1985-86 and 1986-87. The experiment was laid out in split plot design with three replications. The treatment comprised of four sowing dates (October, 26; November, 10; November, 25 and December, 10, - $D_1$, $D_2$, $D_3$, and $D_4$, respectively) as main plot, three seed rates (5.0 , 7.5 and 10.0 kg seed/ha - $R_1$, $R_2$, and $R_3$, respectively) as sub-plot treatments and three phosphorus levels (0, 40 and 80 kg $P_2O_5$/ha - $P_0$, $P_1$ and $P_2$ respectively) as sub-sub plot treatments.

A basal dose of 25 kg N/ha in the form of urea and phosphorus as per treatment in the form of

single super phosphate was given before sowing. The crop was sown at 25 cm apart in rows as per the treatments of sowing dates and seed rates. First cut of green forage was harvested after 55 days of sowing and subsequent cuts were taken up after 25-30 days interval. After taking the last cut of green forage during 3rd March to 11th March, the crop was left for seed production. The seed crop was harvested between 15th to 23rd May during all the three years. One foliar spray of Dithane M-45 was given as a preventive measure for downy mildew disease. BHC 10% dust at the rate of 40 kg/ha alongwith basal fertilizers was given for the control of termites. One spray of Rogar was also given to control aphids-jassids. Other cultivation practices were followed as per recommendations.

The soil was loamy sand, low in organic matter, medium in available phosphorus (26.0 to 27.0 kg $P_2O_5$/ha) and potassium (285 to 289 kg $K_2O$/ha) having pH value of 7.4 to 7.7.

## RESULTS AND DISCUSSION

### Effect of sowing date

The effect of sowing dates on seed, green forage and dry matter yields are reported in Table 1. The data showed that early sowing of lucerne i.e. last week of October ($D_1$) gave significantly higher seed yield than other sowing dates on pooled basis. Similar type of trend was also observed during the years 1985 and 1986. Early sowing of lucerne during last week of October was significantly superior for green forage and dry matter yields over other dates of sowing on pooled basis and also on the results of individual years. Patel *et al.* (1987) reported that last week of October sowing produced significantly higher green forage yield of lucerne than delay sowing of lucerne i.e. last week of November and second week of December. The dry matter yield was also significantly higher in last week of October sowing than sowing of lucerne on second week of December. The experiment was conducted at Anand during 1982-83, 1983-84 and 1984-85. The climatic parameters of Anand and Sardar Krushinagar centres are shown in Fig.1.

Relative profitability of different sowing dates indicated that higher total returns and Net Incremental Cost Benefit Ratio obtained from last week of October sowing (Table 2).

### Effect of seed rates

Lucerne seed rate of 5 kg seed/ha gave significantly higher seed yield of lucerne over 7.5 and 10.0 kg seed/ha during the year 1984-85. The seed yield of lucerne did not differ significantly due to 5 kg and 7.5 kg seed rate/ha but lucerne crop sown with 10 kg seed rate/ha was found significantly superior for green forage and dry matter yields than other seed rates on pooled basis. So in lucerne crop, forage yield is also an important factor which reflects the economic of the crop Maslinkov *et al.* (1980) did not notice any significant increase in seed yield with increase in seed rate. Lucerne crop sown with 10 kg seed rate/ha was found significantly superior for green forage and dry matter yield than other seed rates on pooled basis. This is in line for individual year also. Belzile (1984) reported that lucerne seed rate of 13.4 kg seed/ha yielded more than that of 6.7 kg seed/ha at the first cut and total forage yields of all the cuts. The soil of Sardar Krushinagar is sandy i.e. lighter type of soils and it has great-problem of termites, so plant mortality is higher and hence higher seed rate of lucerne i.e. 10 kg/ha gave significantly higher green forage and dry matter yields than that of lower seeds of 5.0 and 7.5 kg/ha.

Relative profitability of different seed rates of lucerne indicated that higher total returns were obtained when the seed rate of lucerne was used at the rate of 10 kg seed/ha (Table 2).

### Effect of phosphorus levels

The data indicated that application of 80 kg $P_2O_5$/ha gave significantly higher yield than no application of phosphorus during the year 1984-85 and 1986-87, application of 80 kg $P_2O_5$/ha had also produced significantly higher yield over 40 kg $P_2O_5$/ha. Similar type of trend was observed when data were pooled but the yield differences did not reach to the level of significance. It was observed that there was no significant response of seed yield of lucerne even under medium soil available phosphorus.

Experimental results of three years at Anand revealed that foliar application of phosphorus at the rate of 2% or 4% as well as soil application (40 to 120 kg $P_2O_5$/ha) did not show any significant effect on seed yield of lucerne (Anon., 1977-78; 1978-79

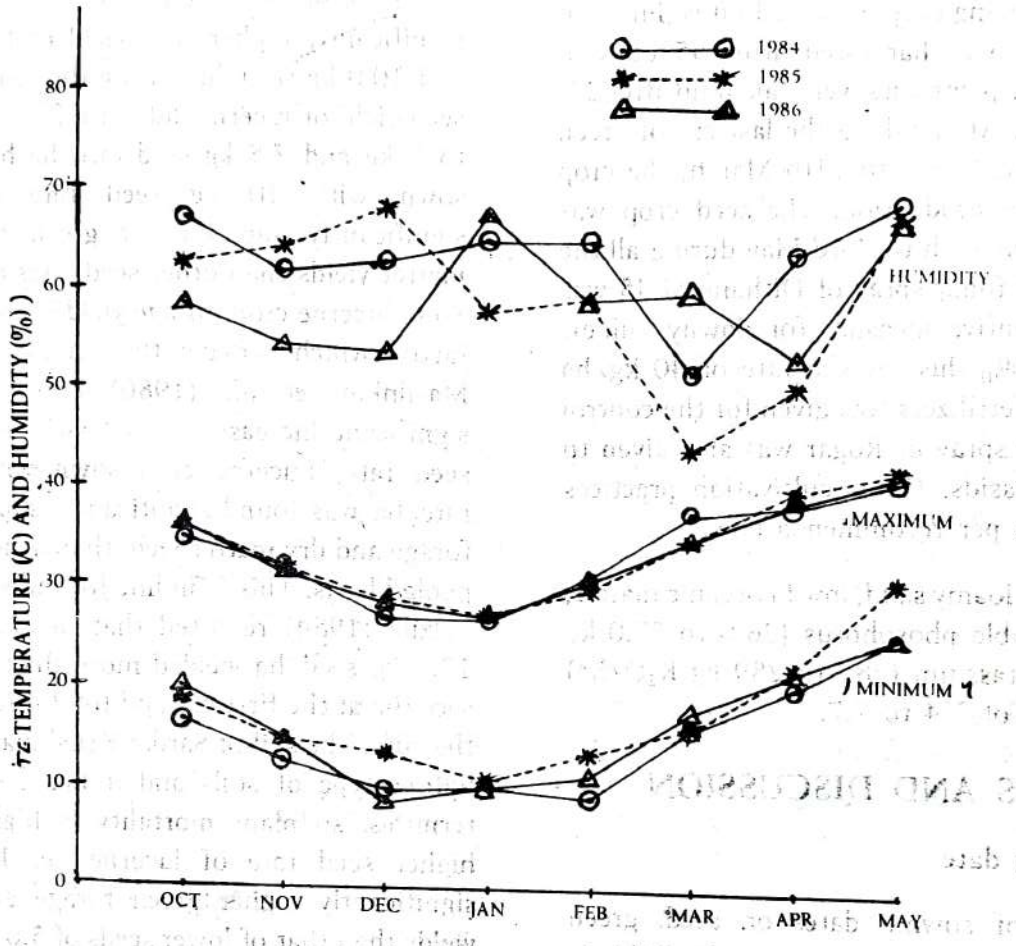


**Fig. 1. Showing weather data during growth period of lucerne**

nd 1979-80). Similar type of results were also btained at Uralikanchan and Jhansi (Anon., 1983-4) Mc Caslin and Gledhill (1980) also did not bserve any effect of phosphorus on seed yield of ucerne.

Considering forage yield of lucerne, it was bserved that application of 80 kg $P_2O_5$/ha to ucerne crop gave significantly higher green forage nd dry matter yields than other phosphorus levels, showed that there was response on forage roduction of lucerne even under medium soil ailable phosphorus.

Relative profitability of different levels of osphorus indicated that application of 80 kg $O_5$/ha recorded higher total returns and net remental cost benefit ratio (Table 2).

The interaction effect was significant for ing dates (D) × phosphorus levels (P) for seed yield of lucerne on pooled basis (Table 3). The interaction of early sowing of lucerne on last week of October ($D_1$) × application of 80 kg $P_2O_5$/ha produced significantly higher seed yield of lucerne than other treatment combinations. The said interaction gave significantly higher green forage and dry matter yields than other treatment combinations (Table 4). Hence, this treatment showed the highest total returns and Net Incremental Cost Benefit Ratio (Table 2).

So present study showed that for obtaining higher net realization and seed yield as well as green and dry forage yields of lucerne variety Anand-2 should be sown in line 25 cm apart during last week of October by keeping seed rate of 10 kg/ha and apply 80 kg $P_2O_5$/ha under Sardar Krushinagar soil condition where available phosphorus is medium (22 to 56 kg $P_2O_5$/ha).

*TABLE 1*

**Effect of seed rates and phosphorus levels on the seed production as well as green forage and dry matter yields of lucerne under different sowing dates.**

| Treatment | Seed yield (kg/ha) | | | | Green forage yield (q/ha) | | | | Dry matter yield (q/ha) | | | | Average plant stand tiller/ m. row |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | Pooled | 1984 | 1985 | 1986 | Pooled | 1984 | 1985 | 1986 | Pooled | |
| **Sowing Date (D)** | | | | | | | | | | | | | |
| 26th October $D_1$ | 141 | 331 | 227 | 233 | 282 | 316 | 311 | 303 | 54.0 | 53.7 | 50.0 | 53.9 | 46.4 |
| 10th November $D_2$ | 96 | 287 | 205 | 196 | 257 | 266 | 220 | 248 | 48.3 | 47.4 | 40.8 | 48.0 | 40.3 |
| 25th November $D_3$ | 98 | 261 | 202 | 187 | 197 | 211 | 196 | 201 | 37.4 | 34.8 | 34.3 | 36.6 | 35.0 |
| 10th December $D_4$ | 87 | 249 | 181 | 172 | 133 | 156 | 127 | 139 | 25.3 | 27.1 | 24.7 | 25.9 | 36.8 |
| S.Em. ± | 3.3 | 13.5 | 3.1 | 4.7 | 14 | 5 | 7 | 6 | 2.4 | 0.9 | 1.2 | 0.9 | — |
| C. D. (5%) | 11.3 | 46.5 | 10.7 | 14.0 | 48 | 18 | 25 | 16 | 8.3 | 3.2 | 4.1 | 2.8 | — |
| **Seed rate (kg/ha)** | | | | | | | | | | | | | |
| 5.0 $R_1$ | 121 | 287 | 204 | 204 | 199 | 218 | 197 | 205 | 38.0 | 37.8 | 34.9 | 37.9 | 37.2 |
| 7.5 $R_2$ | 100 | 272 | 209 | 193 | 219 | 237 | 218 | 224 | 41.4 | 40.8 | 37.9 | 41.2 | 40.8 |
| 10.0 $R_3$ | 97 | 286 | 198 | 194 | 234 | 257 | 226 | 239 | 44.4 | 43.5 | 39.5 | 44.1 | 43.0 |
| S.Em. ± | 2.1 | 11.5 | 2.7 | 4.0 | 3 | 3 | 2 | 2 | 0.6 | 0.5 | 0.5 | 0.3 | — |
| C. D. (5%) | 6.2 | NS | 8.0 | NS | 10 | 9 | 6 | 5 | 1.8 | 1.6 | 1.4 | 0.9 | — |
| **Phosphorus levels (P) ($P_2O_5$ kg/ha)** | | | | | | | | | | | | | |
| 0 $P_0$ | 100 | 293 | 152 | 181 | 201 | 211 | 192 | 201 | 38.0 | 37.1 | 34.8 | 37.7 | 39.6 |
| 40 $P_1$ | 106 | 277 | 200 | 194 | 221 | 237 | 215 | 225 | 42.0 | 40.4 | 36.7 | 41.5 | 40.8 |
| 80 $P_2$ | 111 | 276 | 259 | 215 | 229 | 263 | 234 | 242 | 43.7 | 44.7 | 40.8 | 44.0 | 40.9 |
| S.Em. ± | 2.1 | 6.7 | 3.8 | 14.7 | 4 | 2 | 2 | 0.5 | 0.7 | 0.4 | 0.3 | 0.3 | — |
| C. D. (5 %) | 5.9 | NS | 10.8 | NS | 10 | 5 | 5 | 1.2 | 1.9 | 1.1 | 1.0 | 0.8 | — |

Pooled seed yield (kg/ha), green forage (q/ha), total return additional return over control, additional cost (Rs/ha) as well as gross ICBR and net ICBR of lucerne as effected by sowing dates, phosphorus levels and seed rates.

| *Treatment* | *Pooled seed yield (kg/ha)* | *Pooled green forage yield (q/ha)* | *Total return Rs/ha* | *Additional return over control (Rs/ha)* | *Additional cost (Rs/ha)* | *Gross ICBR* | *Net ICBR* |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Sowing Dates (D)** | | | | | | | |
| $D_4$ | 172 | 127 | 8,216 | — | — | — | — |
| $D_3$ | 187 | 196 | 10,091 | 1,875 | 654 | 1:2.87 | 1:1.87 |
| $D_2$ | 196 | 220 | 10,868 | 2,652 | 1,082 | 1:2.45 | 1:1.45 |
| $D_1$ | 233 | 311 | 13,909 | 5,693 | 1,736 | 1:3.28 | 1:2.28 |
| **Phosphorus (P)** | | | | | | | |
| 0 kg/ha ($P_0$) | 181 | 201 | 9,975 | — | — | — | — |
| 40 kg/ha ($P_1$) | 194 | 225 | 10,902 | 927 | 260 | 1:3.57 | 1:2.57 |
| 80 kg/ha ($P_2$) | 215 | 242 | 11,935 | 1,960 | 520 | 1:3.77 | 1:2.77 |
| **Seed rate (R)** | | | | | | | |
| 5.0 kg/ha ($R_1$) | 204 | 205 | 10,832 | — | — | — | — |
| 7.5 kg/ha ($R_2$) | 193 | 224 | 10,849 | 17 | 247.5 | 1:0.07 | —1:0.93 |
| 10.0 kg/ha ($R_3$) | 194 | 239 | 11,182 | 310 | 330.0 | 1:0.94 | —1:0.06 |
| **Interaction (D×P)** | | | | | | | |
| $D_4P_0$ | 157 | 122 | 7,621 | — | — | — | - |
| $D_3P_0$ | 169 | 188 | 9,337 | 1,716 | 654 | 1:2.52 | 1:1.62 |
| $D_3P_1$ | 179 | 201 | 9,927 | 2,306 | 914 | 1:2.52 | 1:1.52 |
| $D_3P_2$ | 212 | 216 | 11,316 | 3,695 | 1,174 | 1:3.15 | 1:2.15 |
| $D_2P_0$ | 190 | 224 | 10,750 | 3,129 | 1,082 | 1:2.89 | 1:1.89 |
| $D_2P_1$ | 198 | 253 | 11,594 | 3,973 | 1,342 | 1:2.96 | 1:1.96 |
| $D_2P_2$ | 200 | 266 | 11,920 | 4,299 | 1,602 | 1:2.68 | 1:1.68 |
| $D_1P_0$ | 210 | 272 | 12,370 | 4,749 | 1,736 | 1:2.74 | 1:1.74 |
| $D_1P_1$ | 221 | 306 | 13,413 | 5,792 | 1,996 | 1:2.90 | 1:1.90 |
| $D_1P_2$ | 268 | 331 | 15,464 | 7,843 | 2,256 | 1:3.48 | 1:2.48 |

*Selling price of lucerne seed* = Rs.33/kg
Selling price of green gorage yield = Rs.20/q.
Cost of Phosphorus = Rs. 6.5/kg
Harvesting Cost = Rs.440/cut/ha
Irrigation Cost = Rs.214/Irrigation/ha.

TABLE 3
**Interaction table of sowing dates (D) × phosphorus levels (P) for seed yield of lucerne (kg/ha) on pooled basis.**

| D/P | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Me |
|---|---|---|---|---|---|
| $P_0$ | 210 | 190 | 169 | 157 | 1 |
| $P_1$ | 221 | 198 | 179 | 179 | 1 |
| $P_2$ | 268 | 200 | 212 | 181 | 2 |
| Mean | 233 | 196 | 187 | 172 | |
| S.Em. ± | 5.3 | | | | |
| C.D. at 5% | 14.7 | | | | |

TABLE 4
**Interaction table of sowing dates (D) × phosphorus levels (P) for green forage and dry matter yield (q/ha) of lucerne on pooled basis.**

| D/P | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Mean |
|---|---|---|---|---|---|
| $P_0$ | 274 (48.4) | 224 (44.6) | 188 (34.5) | 122 (23.4) | 201 (37.7) |
| $P_1$ | 306 (54.5) | 253 (49.5) | 201 (36.6) | 139 (25.4) | 225 (41.5) |
| $P_2$ | 331 (58.8) | 266 (50.0) | 216 (37.6) | 155 (28.8) | 242 (44.0) |
| Mean | 303 (53.9) | 248 (48.0) | 201 (36.6) | 139 (25.9) | |
| S. Em. ± | 3 (53.9) | | | | |
| C.D. at 5% | 8 (1.6) | | | | |

Figures in parentheses indicates dry matter yield.

## REFERENCES


Anonymous, 1978. Annual Report of Forage Crops Research G.A.U., Anand, pp. 54.

Anonymous, 1979. Annual Report of Forage Crops Research G.A.U., Anand. pp. 70.

Anonymous, 1980. Annual Report of Forage Crops Research G.A.U., Anand, pp. 81.

Anonymous, 1984. Annual progress report of All India Co-ordinated Project for Research on Forage Crops. Indian Grassland and Fodder Research Institute, Jhansi, India. pp. 14.

Belzile, L. 1984. Influence of cultivars, date and rate of sowing on yield and quality of lucerne sown in late summer. *Can. J. Pl. Sci.* 64 :

Maslinkov, M. Mirtscher M. and Antonowa, N. 1980. Studies on the optimal sowing rate for lucerne for seed production. Martin-Luther Universitat Hasle Wiltenberg, 20 (5) pp. 324-335. *Herb. Abst.* 1982, 52 (12) : 544.

McCaslin, B. D. and Gledhill, R. J. 1980. Alfalfa fertilization in New Mexico. New Mexico Agric. Expt. Stn., Bull., 675 : 36. *Herb Abstr.* 1982, 52 (8) : 353.

Patel, J. R., Patel, P. C., Raj, M. F. and Saiyad, M. R. 1987. Effect of sowing date and seed rate on forage yield and quality of different genotypes of lucerne. *Forage Res.*, 13 : 25-32.

Res. J. 1990, 15(2) : 12-17



# Effect of Sowing Time, Phosphorus Level and Seed Rate on Seed Production of Lucerne

J.R. Patel, P.C. Patel, M.F. Raj and M.R. Saiyad

Forage Research Project, Gujarat Agricultural University, Anand 388 110

## ABSTRACT

The results of a field experiment conducted at Forage Research Project, Anand revealed that early ving dates (1st and 15th November) gave higher seed yield than delayed sowings. Economics of sowing tes indicated that higher net incremental cost benefit ratio (ICBR) was obtained from 15th November wing. Phosphorus had no significant effect on seed and forage yields of lucerne. Significantly higher seed ld was obtained with the use of 5 kg seed/ha than 10 kg seed/ha. So also net ICBR was high when cerne was sown at the rate of 5 kg seed/ha. The interaction of 40 kg $P_2O_5$/ha × 5 kg seed/ha gave gnificantly higher seed yield than other interactions barring no application of phosphorus with 5 or 7.5 seed/ha, application of 40 kg $P_2O_5$/ha × 7.5 kg seed/ha and 80 kg $P_2O_5$/ha × 5 kg seed/ha. Its onomics indicated that high net ICBR was obtained when the lucerne crop was sown at the rate of 5 kg ed/ha without application of phosphorus.

*(Received on 6th July, 1988)*

## INTRODUCTION

Lucerne is one of the most important forage rop in Gujarat during winter season particularly or the milkshed area where the livestock roduction is involved. The fertilizer and seed are he costly inputs for seed production of lucerne, herefore, their proper utilization is the matter of onsideration. Sowing date is non-cash input, owever, appropriate time of sowing substantially ncreases the forage yield. As the informations egarding sowing date, seed rate and phosphorus equirement for lucerne seed production in the state are scarce, the present investigation was carried out.

## MATERIALS AND METHODS

Field trial was carried out on lucerne var. Anand-2 for three consecutive *rabi* seasons of 1982-83, 1983-84 and 1984-85 at Gujarat Agricultural University, Anand. The soil of the experimental site was sandy loam, neutral in reaction and low in available nitrogen (207 kg/ha) but high in phosphorus (59 kg $P_2O_5$/ha). The treatments were comprised of four sowing dates (1st, 15th and 30th November and 15th December - $D_1$, $D_2$, $D_3$ and $D_4$, respectively) as main plot, three phosphorus levels (0, 40 and 80 kg $P_2O_5$/ha - $P_0$, $P_1$ and $P_2$, respectively) as sub-plot and three seed rates (5.0, 7.5 and 10.0 kg seed/ha - $R_1$, $R_2$ and $R_3$, respectively) as sub-sub plot treatments in split-split plot design with three replications.

A basal dose of 25 kg N/ha in the form of urea and phosphorus as per treatment in the form of single super-phosphate was given before sowing. The crops was sown at 20 cm apart in rows as per the treatments of sowing dates and seed rates. First cut of green forage was taken after 55 days of sowing and subsequent cuts were harvested after 25 to 30 days interval. The last cut of green forage was taken during 8th March to 16th March (except 28th February in 1984) and thereafter the crop was left for seed production. The seed crop was harvested between 16th to 23rd May during all the three years. Two irrigations were applied after last cut of

green forage. Other cultivation practices were followed as recommended.

The weather data (Fig. 1) indicated that temperature was declined from October to January and had increased thereafter till June. The off seasonal rainfall (273.6 mm) was more during 1982-83, whereas during 1983-84 and 1984-85, it was 19.1 and 2.8 mm, respectively.

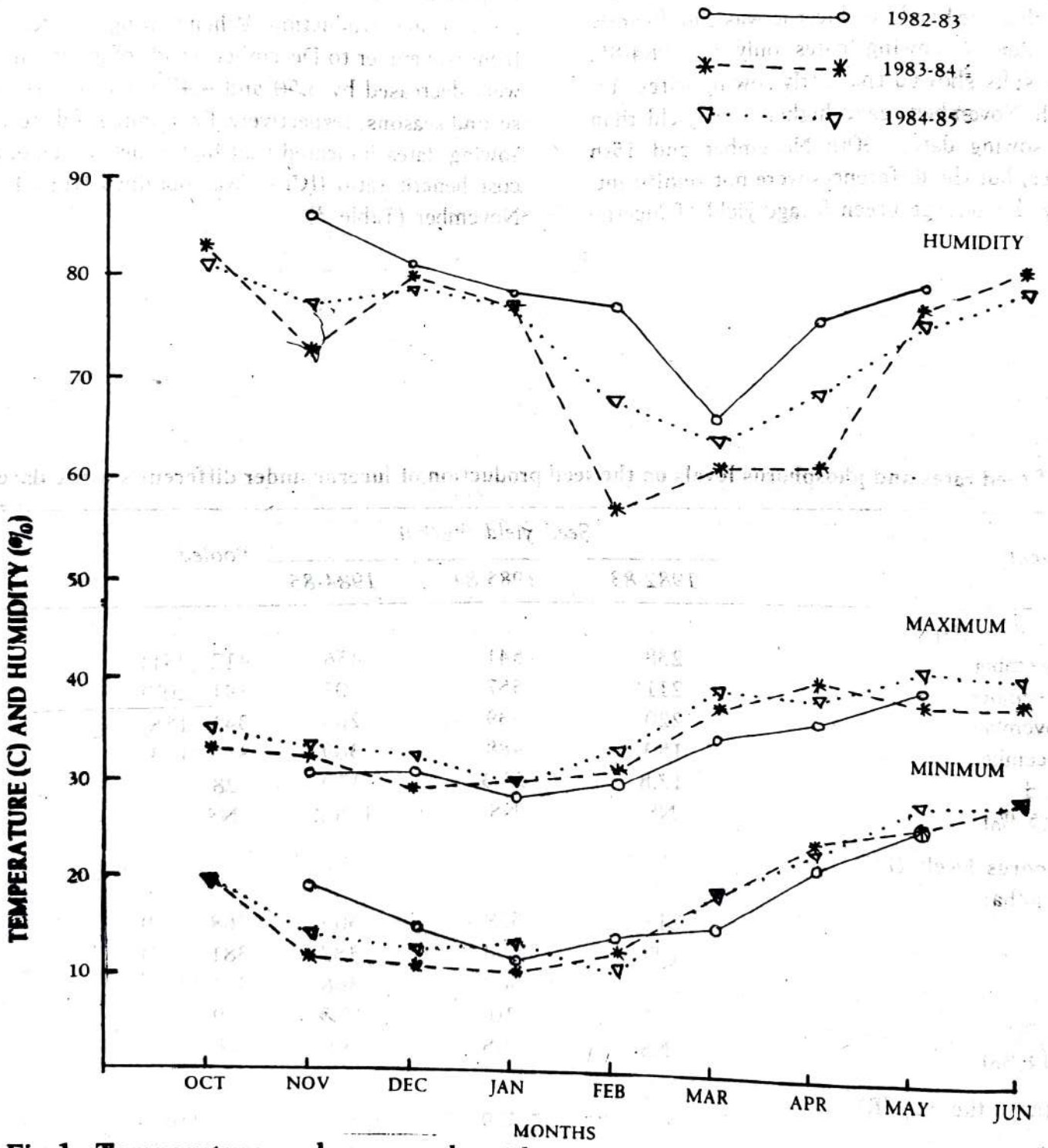


**Fig.1. Temperature and average humidity data during growth period of lucerne**

## RESULTS AND DISCUSSION

### ffect of sowing date

The effect of sowing dates on seed and green orage yields are presented in Table 1. The data ndicate that seed yield of lucerne was significantly ffected due to sowing dates only in 1984-85. ooled results showed that early sowing dates (1st nd 15th November) gave higher seed yield than elayed sowing dates (30th November and 15th ecember) but the differences were not significant. imilarly the average green forage yield of lucerne reduced drastically by successive delay in sowing. The lower temperature (Fig. 1) during the month of January might have affected adversely the growth of late sown crop. On the basis of field studies, Wynn-William (1976) indicated that spring sown crop (September, October or November) gave the highest green forage production. When sowing was delayed from November to December, yields of green forage were decreased by 3.50 and 4.47 t/ha in first and second seasons, respectively. Economics of different sowing dates indicated that higher net incremental cost benefit ratio (ICBR) was obtained from 15th November (Table 3).

*ABLE 1*

**ffect of seed rates and phosphorus levels on the seed production of lucerne under different sowing dates.**

| *Treatment* | *Seed yield (kg/ha)* | | | *Pooled* |
|---|---|---|---|---|
| | *1982-83* | *1983-84* | *1984-85* | |
| **Sowing date (D)** | | | | |
| 1 November | 238 | 541 | 456 | 412 (251) |
| 15 November | 211 | 557 | 407 | 391 (207) |
| 30 November | 220 | 539 | 263 | 341 (188) |
| 15 December | 150 | 488 | 369 | 337 (123) |
| S. Em. ± | 17.8 | 23.3 | 37.1 | 28 |
| C. D. (5 %) | NS | NS | 128.2 | NS |
| **Phosphorus levels (P)** ($P_2O_5$kg/ha) | | | | |
| 0 | 211 | 529 | 365 | 368 (190) |
| 40 | 199 | 556 | 387 | 381 (193) |
| 80 | 208 | 508 | 368 | 361 (195) |
| S. Em. ± | 3.5 | 10 | 13.5 | 9 |
| C. D. (5 %) | NS | NS | NS | NS |
| **Seed rates (kg/ha) (R)** | | | | |
| 5.0 | 224 | 569 | 384 | 392 (181) |
| 7.5 | 210 | 552 | 371 | 378 (194) |
| 10.0 | 184 | 473 | 366 | 341 (203) |
| S. Em. ± | 6.0 | 10.0 | 11.1 | 13 |
| C. D. (5 %) | 15.5 | 28.4 | NS | NS |

Figures in parentheses indicate average green forage yield (q/ha).

*TABLE 2*

**Interaction table of phosphorus level (P) and seed rate (R) for seed yield of lucerne for the year 1984-85 and on pooled basis.**

| *R/P* | *Seed yield (kg/ha)* | | | | | |
|---|---|---|---|---|---|---|
| | *1984-85* | | | *Pooled* | | |
| | $P_0$ | $P_1$ | $P_2$ | $P_0$ | $P_1$ | $P_2$ |
| $R_1$ | 372 | 379 | 403 | 379 | 404 | 394 |
| $R_2$ | 391 | 398 | 322 | 395 | 388 | 350 |
| $R_3$ | 334 | 384 | 380 | 331 | 351 | 340 |
| S. Em. ± | | 19 | | | 9 | |
| C. D. (5 %) | | 55 | | | 25 | |

**Interaction table of sowing date (D) and seed rate (R) for seed yield of lucerne for the year 1982-83.**

| *D/R* | *Seed yield (kg/ha)* | | | *Mean* |
|---|---|---|---|---|
| | $R_1$ | $R_2$ | $R_3$ | |
| $D_1$ | 248 | 234 | 233 | 238 |
| $D_2$ | 227 | 208 | 197 | 211 |
| $D_3$ | 248 | 245 | 168 | 220 |
| $D_4$ | 172 | 155 | 137 | 150 |
| Mean | 224 | 210 | 184 | |
| S. Em. ± | | 10.0 | | |
| C. D. (5 %) | | 31.0 | | |

**Effect of phosphorus**

The data indicated that the phosphorus levels had no significant effect on seed yield of lucerne in three years as well as when data were pooled (Table 1). Green forage yield was also not altered by phosphorus supplementation. One of the reasons for obtaining no response of phosphorus might be due to availability of high phosphorus in the soil. Experimental results of three years at Anand revealed that foliar application of phosphorus at the rate of 2% or 4% along with its soil application (40 to 120 kg $P_2O_5$/ha) did not show any significant effect on seed yield of lucerne (Anonymous, 1977-78, 1978-79, and 1979-80). The experimental soil have high availability of phosphorus ranges from 62 to 83 kg $P_2O_5$/ha. McCaslin and Gledhill (1982) also did not observe any effect of phosphorus on seed yield of lucerne.

Economics of different levels of phosphorus indicated that total return received more from the application of 40 kg $P_2O_5$/ha but it showed low net ICBR while the treatment of 80 kg $P_2O_5$/ha showed negative net ICBR (Table 3).

TABLE 3

**Economics of lucerne seed as influenced by dates of sowing, seed rates and phosphorus levels.**

| *Treatments* | *Pooled seed yield (kg/ha)* | *Total return (Rs/ha)* | *Additional return over control (Rs/ha)* | *Additional cost (Rs/ha)* | *Gross ICBR* | *Net ICBR* |
|---|---|---|---|---|---|---|
| **Sowing dates** | | | | | | |
| **1st Nov. $D_1$** | 412 | 14,496 | 4285 | 1350 | 1:3.17 | 1:2.17 |
| 15th Nov. $D_2$ | 391 | 13,133 | 2922 | 780 | 1:3.75 | 1:2.75 |
| 30th Nov. $D_3$ | 341 | 11,603 | 1392 | 570 | 1:2.44 | 1:1.44 |
| 15th Dec. $D_4$ | 337 | 10,211 | — | — | — | — |
| **Phosphorus** | | | | | | |
| 0 kg/ha | 368 | 12,264 | — | — | — | — |
| 40 kg/ha | 381 | 12,623 | 359 | 220 | 1:1.63 | 1:0.63 |
| 80 kg/ha | 361 | 12,203 | -61 | 440 | -1:0.14 | -1:1.14 |
| **Seed rate** | | | | | | |
| 5.0 kg/ha | 392 | 12,636 | 733 | 115 | 1:0.37 | 1:5.37 |
| 7.5 | 378 | 12,574 | 671 | 173 | 1:3.88 | 1:2.88 |
| 10.0 kg/ha | 341 | 11,903 | — | — | — | — |
| **Interaction (P × R)** | | | | | | |
| $P_0R_1$ | 379 | 13,717 | 804 | 115 | 1:6.99 | 1:5.99 |
| $P_0R_2$ | 395 | 14,085 | 1172 | 173 | 1:6.78 | 1:5.78 |
| $P_0R_3$ | 331 | 12,913 | — | — | — | — |
| $P_1R_1$ | 404 | 14,292 | 1379 | 235 | 1:5.87 | 1:4.87 |
| $P_1R_2$ | 388 | 13,924 | 1011 | 393 | 1:2.57 | 1:1.57 |
| $P_1R_3$ | 351 | 13,073 | 160 | 450 | 1:0.36 | -1:0.64 |
| $P_2R_1$ | 394 | 14,062 | 1149 | 555 | 1:2.07 | 1:1.07 |
| $P_2R_2$ | 350 | 13,050 | 137 | 613 | 1:0.22 | -1:0.78 |
| $P_2R_3$ | 340 | 12,820 | — | 670 | — | — |

Selling price of lucerne seed = Rs.23/kg
Selling price of green forage yield = Rs.20/q
Cost of phosphorus = Rs.5.5/kg
Harvesting cost = Rs.360/cut/ha
Irrigation cost = Rs.210/Irri./ha

**Effect of Seed Rate**

Lucerne seed rate of 5 kg seed/ha gave significantly higher seed yield of lucerne over 10 kg seed/ha but at par with 7.5 kg seed/ha during the year 1982-83 and 1983-84. Similar trend was also observed in the year 1984-85 as well as on pooled basis but the differences were not significant. Sevecka (1979) reported that the highest seed yield of lucerne was obtained with the lowest seed rate of 5 kg seed/ha. Similarly, Craiu *et al.* (1984), also found that 6 kg/ha seed rate was the optimum for obtaining the highest yield. So also, Maslinkov *et al.* (1982) did not notice any significant increase in seed yield with increase in seed rate.

Economics of different seed rates indicated that high net ICBR was obtained when the seed rate of lucerne used was at the rate of 5 kg seed/ha (Table 3).

The interaction of R × P was significant for seed yield of lucerne during the year 1984-85 and on pooled basis. The interactions of $R_1P_2$ (403 kg/ha) and $R_1P_1$ (404 kg/ha) gave significantly higher seed yield during 1984-85 and on pooled basis respectively than $R_2P_2$ and $R_3P_0$. The interactions of $R_3P_1$ and $R_3P_2$ were also significantly lower in seed yield than $R_1P_1$ on pooled basis (Table 2). Economics of the said interactions indicated that high net ICBR was obtained when the lucerne crop was sown at the rate of 5 kg seed/ha in the absence of phosphatic fertilizer (Table 3).

These results indicated that the lucerne variety Anand-2 should be sown in line (20 cm) during 2nd week of November (15th November) by keeping the seed rate of 5 kg seed/ha for obtaining high seed yield of lucerne and also net realization. Applicati of phosphorus did not require under Anand s conditions where availability of phosphorus is hig

## REFERENCES


Anonymous, (1977-78). Annual Report of Fora Crops Research, GAU, Anand.

Anonymous, (1978-79). Annual Report of Fora Crops Research, GAU, Anand.

Anonymous, (1979-80). Annual Report of Fora Crops Research, GAU, Anand.

Craiu, D. A., Florea, I. Gaidanov and M. Negri (1984). Experimental results with lucern seed crops in the Danube Plain. *Herb. Abstr* 54 (12) : 387.

McCaslin, B. D. and R. J. Gledhill (1982). Alfalf fertilization in New Mexico. *Herb. Abstr.*, 5 (8) : 353.

Maslinkov, M.; M. Mirtschev and N. Antonow (1982). Studies on the optimal sowing ra for lucerne for seed production. *Herb. Abstr* 52 (12) : 544.

Sevecka, L. (1979). Effect of stand layout an utilization method on seed yields of lucern *Herb. Abstr.*, 49 (12) : 549.

Wynn-William, R. B. (1976). Effect of sowing dat on lucerne emergence, survival, nodulatio and early growth. *N.Z. J. Expt. Agric.*, 4 (4) 439-445.

AU Res. J. 1990. 15 (2) : 18-22

# Combining Ability Analysis Over Environments in Sorghum

R. H. Patel and K. B. Desai


## ABSTRACT

The line × tester analysis in Sorghum revealed that the gca and sca effects were significant for all the aits studied at four locations. 296A and 2077A among females and M 50, M 35 and M 34 among males ere good general combiners for grain yield, number of grains per plant and panicle length. These enotypes also exhibited high sca effect in cross combinations among themselves for number of primaries, anicle length, number of grains and grain yield per plant.


The capacity of a genotype to transmit its superiority to its offspring can be best judged by combining bility analysis. The combining ability analysis also helps the plant breeder in identification of desirable arents as well as superior $F_1$ hybrids to be used for subsequent selection in segregating generations. The resent study was conducted to estimate combining ability from a line × tester analysis.

*(Received on 29th March, 1985)*

## MATERIALS AND METHODS

Five female lines were crossed with twenty-two ansformed male lines adopting line × tester ating design. The resultant 110 $F_1$ hybrids longwith the 27 parents were grown in a ndomized block design with three replications at our different locations namely Navsari, Surat, agudan and Deesa during *Kharif* 1981. The ndividual plot consisted of three rows, 3.0 m long, paced 45 and 15 cm between row-to-row and plant-o-plant within row, respectively. Observations were ecorded on 5 randomly selected plants from each lot on days to 50 per cent bloom, plant height cm), panicle length (cm), number of *primaries*, 00-grain weight (g) number of grains per plant and rain yield per plant (g). The data were analysed for ombining ability effects and variances following Iempthorne (1957) and Rao *et al.* (1968).

## RESULTS AND DISCUSSION

The analysis of variances for combining ability or seven characters over locations are presented in able 1. The data revealed that there were gnificant differences among the locations with spect to all the traits except 100 grain weight. The gnificant differences were observed among both males and males for all the characters.

Females × males interaction was also highly significant. It suggested that females manifested differential behaviour with different males for all the traits. Data further revealed that both males and females interactions with locations were significant for most of the characters. However, males appeared relatively stable over locations. Females × males × locations interactions for most of the attributes were significant indicating differential behaviour of males with different females was not stable over the locations. These results agreed with the findings of Singhania (1972). Development of stable genotypes demands the testing of material over entire range of agroclimatic conditions. This could be particularly true in case of improvement of those characters which are influenced largely by fluctuations in environments.

Estimate of variance components showed predominant role of both additive and non-additive genetic variance in the inheritance of most of the traits. However, estimate of $\sigma^2$ gca was smaller in magnitude as compared to that of $\sigma^2$ sca for all characters except days to 50 per cent bloom, 100 grain weight and grain yield per plant. Kambel and Webster (1965), Rao 1970c, Thanky *et al.* (1981) and Patel *et al.* (1982) reported significant influence of both the variances $\sigma^2$ gca and $\sigma^2$ sca on various characters.

*TABLE 1*
**Analysis of variance for various characters over locations.**

| Source | df | MEAN SQUARES | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *Days to 50% bloom* | *Plant height* | *Panicle length* | *Number of primaries* | *100 grain weight* | *Number of grains per plant* | *Grain yield per plant* |
| Locations | 3 | 31.53** | 333583.33** | 2196.93** | 22634.70** | 0.03 | 16355000** | 14115.00** |
| Replications within locations | 8 | 40.98** | 1305.25** | 100.59** | 298.35** | 0.56** | 728875** | 787.50** |
| Females | 4 | 5927.40** | 18575.25** | 3880.80** | 10960.40** | 16.30** | 44256500** | 121693.50** |
| Males | 21 | 140.12** | 6028.48** | 96.68** | 704.68** | 1.11** | 12574761** | 12817.04** |
| Females × Males | 84 | 47.34** | 1034.46** | 22.16** | 224.07** | 0.16** | 2600976** | 3885.62** |
| Females × Locations | 12 | 4.38 | 1522.75** | 223.50** | 273.56** | 0.07* | 252583* | 707.42** |
| Males × Locations | 63 | 6.70 | 462.51** | 10.56** | 103.09** | 0.03 | 292952* | 651.81** |
| (Females × Males) location | 252 | 7.09* | 282.17* | 8.29** | 78.32** | 0.03 | 188179 | 619.86* |
| Error | 872 | 6.29 | 254.60 | 6.07 | 40.86 | 0.04 | 208185 | 526.81 |
| $\sigma^2$ gca | | 18.44 | 65.17 | 3.26 | 33.94 | 0.05 | 158828 | 390.80 |
| $\sigma^2$ sca | | 13.81 | 83.59 | 4.77 | 48.58 | 0.04 | 268089 | 362.86 |
| $\sigma^2$ gca × locations | | 0.03 | 19.49 | 20.10 | 2.72 | 0.01 | 2092 | 1.49 |
| $\sigma^2$ sca × locations | | 0.82 | 25.18 | 2.83 | 25.14 | 0.03 | 107104 | 93.16 |

*P = 0.05, **P = 0.01

TABLE 2

**General combining ability effects for parents.**

| *Characters* | *Days to 50% bloom* | *Plant height* | *Panicle length* | *Number of primaries* | *Hundred grain weight* | *Number of grains/ plant* | *Grain yield/ plant* |
|---|---|---|---|---|---|---|---|
| **Females** | | | | | | | |
| ms 296 | 3.37** | 0.47 | 4.47** | 8.92** | 0.24** | 303.97** | 20.68** |
| ms 323 | 3.40** | 4.00** | -2.15** | -1.07** | 0.19** | -120.05** | 3.78** |
| ms 2077 | 1.96** | 9.57** | 3.85** | 3.90** | -0.01 | 537.34** | 18.14** |
| ms 2219 | -7.90** | -13.15** | -2.78** | -6.63** | -0.39** | -446.95** | -30.41** |
| ms 3660 | -0.82** | -0.89 | -3.40** | -5.11** | -0.04** | -274.32** | -12.18** |
| SE (gj) ± | 0.124 | 0.787 | 0.128 | 0.329 | 0.015 | 27.383 | 1.235 |
| **Males** | | | | | | | |
| M 34 | 1.25** | -10.27** | 1.82** | 6.32** | -0.08** | 516.30** | 13.47** |
| M 35 | -0.47 | -7.72** | 2.39** | 5.27** | -0.01 | 640.82** | 25.48** |
| M 36 | -0.65 | -2.87 | -1.15** | -1.25 | -0.01 | -54.27 | -1.14 |
| M 37 | 0.53 | -6.62** | 0.12 | -3.65** | 0.23** | -640.65** | -19.29** |
| M 38 | 0.12 | 2.06 | 0.26 | 1.04 | -0.12** | 278.35** | -13.93** |
| M 39 | 0.70 | 6.43** | -0.69 | -3.07** | -0.20** | 162.22** | -1.24 |
| M 40 | 0.26 | 5.08** | 0.75** | -0.44 | -0.01 | -131.30 | -5.39 |
| M 41 | -2.19** | 19.80** | -0.40 | -2.08** | -0.01 | -391.03** | -12.22** |
| M 42 | 1.44** | 1.88 | -0.82** | -0.44 | -0.04 | -121.95 | -6.12 |
| M 43 | 0.28 | 2.80 | 1.37** | 4.19** | -0.08** | 877.88** | 28.17** |
| M 44 | -0.94** | 21.13** | -1.56** | -1.43 | 0.13** | -457.97** | -12.74** |
| M 45 | 2.19** | -5.69** | 0.41 | 0.15 | 0.09** | 12.97 | 1.63 |
| M 46 | 1.44** | -3.34 | -0.90** | 0.83 | -0.16** | -44.02 | -8.41** |
| M 47 | 0.46 | -2.49 | 0.63 | 1.23 | -0.07** | 266.78** | 7.33** |
| M 48 | 2.57** | 2.10 | 0.39 | -0.54 | 0.01 | -488.82** | -3.38 |
| M 49 | 0.77** | 20.96** | -1.34** | -1.49 | 0.42** | -646.82** | -11.70** |
| M 50 | -0.30 | -6.47** | 3.12** | 8.82** | 0.01 | 1050.53** | 34.15** |
| M 51 | -4.48** | +15.02** | 0.32 | -3.61** | -0.15** | -44.18 | -6.63 |
| M 52 | -0.67 | -7.94** | -0.72 | -1.00 | -0.09** | -149.30 | +10.53** |
| M 53 | -1.75** | -4.35 | -1.31** | -4.66** | -0.07** | -341.38** | -16.80** |
| M 54 | -0.37 | -11.22** | -0.82** | -3.18** | -0.09** | -250.17** | -3.75 |
| M 55 | -0.20 | 1.76 | -0.89** | -0.99 | -0.04 | -47.00 | -4.01 |
| SE (gj) ± | 0.283 | 1.803 | 0.278 | 0.753 | 0.023 | 62.783 | 2.830 |

*P = 0.05 **P = 0.01.

*TABLE 3*

**Specific combining ability effects for different characters of 5 best hybrids.**

| Sr. No. | | Days to 50% bloom (for earliness) | Plant height (for dwarfness) | Panicle length | Number of primaries | 100 grain weight | Number of grains/ plants | Grain yield per plant |
|---|---|---|---|---|---|---|---|---|
| 1. | $F_1$ | 3660 A × M 53 | 323 A × M 49 | 2077 A × M 50 | 2077 A × M 34 | 2219 A × M 45 | 366 A × M 45 | 323 A × M 48 |
| | SCa | -5.36 | -24.05 | 3.48 | 0.92 | 0.30 | 1023.75 | 48.20 |
| 2. | $F_1$ | 2077 A × M 55 | 3660 A × M 46 | 2219 A × M 53 | 296 A × M 35 | 2219 A × M 38 | 296 A × M 34 | 2077 A × M 34 |
| | sca | -3.97 | -19.19 | 3.12 | 8.38 | 0.22 | 948.96 | 33.27 |
| 3. | $F_1$ | 3660 A × M 51 | 3660 A × M 47 | 2077 A × M 34 | 296 A × M 50 | 323 A × M 52 | 296 A × M 50 | 3660 A × M 45 |
| | sca | -3.69 | -18.62 | 3.07 | 8.18 | 0.21 | 936.89 | 32.36 |
| 4. | $F_1$ | 323 A × M 37 | 296 A × M 44 | 2077 A × M 35 | 2077 A × M 43 | 2077 A × M 34 | 296 A × M 34 | 296 A × M 50 |
| | sca | -3.52 | -17.44 | 2.96 | 7.68 | 0.19 | 718.84 | 31.76 |
| 5. | $F_1$ | 2219 A × M 45 | 2219 A × M 44 | 296 A × M 43 | 296 A × M 43 | 296 A × M 39 | 323 A × M 54 | 296 A × M 35 |
| | sca | 3.43 | -14.74 | 2.47 | 7.38 | 0.28 | 718.28 | 30.04 |

The relative magnitude of gca and sca also varied with the change in the genetic architecture of the parental population involved, sca assuming greater importance in combination of greater diversity. But in the study of interaction of gca and sca with locations, there were fluctuating results. Kambel and Webster (1965) observed gca to be stable over environments while Liang *et al.* (1968) found sca to be more stable.

An overall appraisal of gca effects revealed that female lines 296 A and 2077 A were good general combiners for grain yield per plant, panicle length and number of primaries. For earliness, 2219 A was the best general combiner among females. Similarly among males, M 34, M 35 and M 50 were good general combiners for dwarfness, grain yield and number of grains per plant. On the contrary, M 49 was a good general combiner for grain weight. Specific combining ability of most promising hybrids for different characters are given in Table 3. Results indicated that crosses of 296 A and 2077 A with M 50, M 34 and M 35 exhibited desirable sca effects. Among better parents, 296, M 50 and M 35 had high gca effects and also exhibited high sca effect in cross combination among themselves for number of primaries, panicle length, number of grain and grain yield per plant. It indicated that these parents have highest yielding potentiality in hybrid breeding programme (Srihari and Nagur. 1980).

The hybrids 296 A × M 50 and 2077 A × M 35 could be used for commercial planting after evaluating for diseases and pests.

## REFERENCES

Kambel, A. E. and Webster, O. J. (1965). Estimates of general and specific combining ability in grain sorghum. Sorghum vulgare pers. *Crop Sci.* **5** : 521-523.

Kempthorne, O. (1957). "An introduction to genetic statistics". John Wiley and Sons, Inc. Newyork.

Liany, G. H. L., Heyne, E. G., Chung, J. M. and Koh, Y. O. (1968). The analysis of heritable variation for three agronomic traits in a 6-variety diallel of grain Sorghum (*Sorghum vulgare* Pers.) *Can. J. Genet. Cytol.* **10** : 460-469.

Patel, R. H., Desai, K. B. and Dabholkar, A. R. (1982). Combining ability for grain yield and its components in Sorghum. *Indian J. Agric. Sci.* **52** : 713-717.

Rao, N. G. P. (1968). Some consideration in breeding for higher yield. *Indian. J. Genet.* **28 A** : 31-42.

Srihari, A. and Nagur, T. (1980). Combining ability studies in Sorghum. *Sorghum news letter* **23** : 12.

Thankey, H. H., Desai K. B. and Tikka, S. B. S. (1981). Heterosis and combining ability in grain sorghum. *GAU Res. J.* **6 (2)** : 65-71.

GAU Res. J. 1990. 15 (2) : 23-27

# Genetic Analysis in Wheat

H. R. Kher, P. P. Zaveri, J. R. Patel and A. R. Pathak

Pulses Research Project, Gujarat Agricultural University, Sardar Krushinagar-385 506, Gujarat

## ABSTRACT

**The weighted least square estimates of gene effects for five characters of four wheat crosses indicated that additive-dominance model was adequate to explain variation in six basic generations for majority of characters. The significance of additive (*d*) and dominance (*h*) parameters however could be detected only in few cases. The *d* and dominance × dominance interaction (*l*) played significant role in genetic determination of tiller number of Raj 1972 × WH 283. For spike length of Kalayansona×Lok 1 *d*, *h* and *l* effects were significant. Grain yield per plant and kernels per spike of two hybrids registered significant epistatic effects alongwith *d* and *l* components. The cross VW 110 × WH 291 depicted significant role of dominance in the interaction of kernels per spike and kernel weight. The latter character was found to be influenced by significantly negative *d* and *l* effects. In view of significant contribution of interaction effects, the population improvement approach was suggested for generating transgressive segregants.**

*(Received on 14th December, 1988)*

## INTRODUCTION

The primary objective of breeding wheat, an autogamous cereal, is to improve both, grain yield and quality. Grain yield is a complex trait being dependent on several component characters. The information on inheritance of these quantitative characters is useful in designing the appropriate breeding procedure and also predicting the performance of the material before the actual practice of selection. The generation mean analysis has been used earlier by several workers for genetical analysis of quantitative traits. However, most of these studies have exploited either three of six parameters model.This paper describes genetical analysis of five characters recorded in four wheat crosses based on the employment of best fitting three, four or five parameter models.

## MATERIALS AND METHODS

The basic set of six generations viz., $P_1$, $P_2$, $F_1$, $F_2$, $B_1$ ($F_1 \times P_1$) and $B_2$ ($F_1 \times P_2$) derived from four wheat crosses namely, Raj 1972 × WH 283 (cross 1), Kalyansona × Lok 1 (cross 2) VW 110 × WH 291 (cross 3), UP 301 × Sonalika (cross 4) wer each raised in a seperate block of land during rab 1984-85 following individual plant randomizatio as described by Mather and Jinks (1977). Fo planting of experiments, the family size wa deliberately varied with the kind of generation. I was set at as low as 30 for the genetically uniform parents and $F_1$s. For segregating families, it was 10 for $F_2$'s. and 70 for back crosses in each cross t compensate for the greater variation expected i these segregating families. The seeds were sown at distance of 100 cm in 2.25 metre long row plot wit inter row spacing of 30 cm. Recommended packag of practices were followed throughout the cro season. The observations were recorded on individual plant basis for five characters in each cross (Table 1). Cavalli's, (1952) joint scaling test was employed to detect the presence of epistasis as well as to obtain weighted least square estimates of additive (d) and dominance (h) gene effects. Whenever this simple additive dominance model failed to be adequate to explain the variation in generation means, the six parameters perfect fit solution advocated by Jinks and Jones (1958) was used to estimates main and interaction effects. The

veighted least square estimates of best fitting four r five parameter models were obtained after emoval of non-significant interaction parameters n six parameters model as described by Mather and inks (1971).

## RESULTS AND DISCUSSION

The estimates of genetic parameters for different characters recorded in four crosses are presented in Table 1. Since the variation among six generation means was not significant for tiller number in cross 1 and spike length in crosses 1 and 4, their data were not subjected to generation mean analysis. The goodness of fit of the model concerned was tested through chi-square test. The non-significant $x^2$ values associated with different characters (Table 1) suggested that the models used were adequate and the parameters estimated were sufficient to explain the variation in generation means. The parameters m was found to be significant in all cases. For tiller number only in Raj 172 × WH 283, the additive (d) and dominance × dominance (l) interaction effects were significant. Singh *et al.* (1984 b) and Vaghani (1985) have also reported importance of additive and epistatic interaction for tiller number in wheat. The genetic of this character was not clear in crosses 3 and 4 where additive-dominance model was found to be adequate but both (d) and (h) effects were non significant. The additive (d), dominance (h) and dominance × dominance (l) effects played significant role in the genetic control of spike length of progenies of Kalyansona × Lok 1. Similar results were also reported by Singh *et al.* (1984 a) but Vaghani (1985) did not observe influence of epistatic interaction for spike length. The analysis of kernels per spike suggested that though simple model was satisfactory for crosses 2 and 3, only dominance effect was significant in cross 3. Except for (i) interaction all the effects were significant in cross 2 for this trait. This result corroborates the findings of Singh *et al.* (1984 a). The significant role of dominance and additive × additive effects was noted in cross 4.

The magnitude of the estimated (h) component for spike length and kernels per spike was higher than (d) component and the negative sign associated with it indicated that the genes possessed by low scoring parents for these characters were in general dominant over the genes possessed by higher scoring parents. Moreover, the influence of largely duplicated type of epistatis was noted for kernels per spike in cross 2 in view of opposite sign associated with (h) and (l) parameters. The $x^2$ test showed that simple additive-dominance model was satisfactory to describe variation in generation means for kernel weight per spike in first three hybrids whereas for forth hybrid, the model involving additional (i) parameter was adequate. Neither additive (d) nor dominance (h) effect was significant for first three crosses except (h) component in case of cross 3 for this trait. In cross 4 (h) and (i) genetic parameters were significant and negative. The additive and dominance components for grain yield per plant were not significantly different from zero in crosses 2 and 3 where adequacy of simple model was indicated by joint scaling test. Fitting of five parameter model showed that the grain yield per plant was governed by (d) and (j) effects in cross 1 and (h) and (l) effects in cross 4. The significance of interaction effects for grain yield in wheat in addition to main effects has also been reported by Singh *et al.* 1984 a and b, and Vaghani 1985. The opposite sign associated with later two parameters suggested that duplicated type of gene action was operative for this character in cross 4. This was also the case with the results reported by Ketata *et al.* (1976). As described by Mather & Jinks (1971) in a polygenic system where many pairs of interacting genes are at work, the sign of i's, j's or d's of individual pair of genes or the sign of their balance can not be safely infered from the sign of absolute value of (i), (j) or (d). Moreover, the dispersion of homozygous loci in the parents influences these three genetic parameters. The (h) and (l) remain free from such influence. Therefore, the sign associated with (h) and (l) parameters was considered reliable to describe the type of largly present epistasis in the present study.

As explained earlier, the goodness of fit for six parameter model of Jinks and Jones (1958) could not be tested in the present study because the number of parameters estimated were equal to number of generation means available which left no degress of freedom for $x^2$ test. Therefore, the non significant interaction parameters of a perfect fit solution were omitted and weighted least square estimates based on the remaining four or five parameters were obtained in such cases. It was observed that this exercise resulted into increased precision of the estimated parameters in addition to

*TABLE 1*

**Estimate of gene effects for different characters of four crosses based on best fitting model.**

| *Character* | *Cross (a)* | *m* | *(d)* | *(h)* | *(i)* | *(j)* | *(l)* | *($x^2$)* | *d.f.(+)* |
|---|---|---|---|---|---|---|---|---|---|
| Tiller number | 1 | 9.50** ±0.70 | 2.41** ±0.62 | -5.16 ±2.90 | — — | — — | 6.91* ±3.11 | 1.41 | 2 |
| | 3 | 5.48** ±0.66 | -0.23 ±0.63 | 2.64 ±1.44 | — | — | — | 0.55 | 3 |
| | 4 | 7.43** ±0.70 | 0.84 ±0.66 | 0.62 ±1.36 | — | — | — | 5.76 | 3 |
| Spike length | 2 | 9.91** ±0.14 | 1.13** ±0.14 | -3.44** ±0.71 | — | — | 3.82** ±0.84 | 0.59 | 2 |
| | 3 | 10.42** ±0.37 | 0.56 ±0.31 | 0.61 ±0.73 | — | — | — | 0.66 | 3 |
| Kernels per spike | 1 | 49.31** ±1.63 | -0.63 ±1.51 | 1.06 ±3.11 | — | — | — | 3.86 | 3 |
| | 2 | 62.32** ±2.04 | 17.55** ±2.04 | -25.58** ±8.11 | — | -20.83** ±7.18 | 24.74** ±8.20 | 0.72 | 1 |
| | 3 | 56.40** ±3.79 | 0.57 ±3.40 | 17.01* ±7.08 | — | — | — | 2.57 | 3 |
| | 4 | 81.32** ±6.11 | 2.91 ±1.95 | -38.29 ±9.50 | -39.66** ±6.56 | — | — | 2.25 | 2 |
| Kernel weight per spike | 1 | 2.34** ±0.11 | -0.01 ±0.01 | 0.31 ±0.20 | — | — | — | 2.87 | 3 |
| | 2 | 3.05** ±0.14 | -0.01 ±0.13 | -0.03 ±0.22 | — | — | — | 2.00 | 3 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| | 3 | 2.44** ±0.19 | -0.09 ±0.18 | 0.99** ±0.36 | — | — | — | 0.56 | 3 |
| | 4 | 3.16** ±0.34 | -0.12 ±0.11 | -0.93* ±0.45 | -1.23** **0.37 | — | — | 0.14 | 2 |
| Grain yield per plant | 1 | 18.61** ±1.69 | 4.19* ±1.91 | -6.66 ±8.11 | — | 12.10* ±6.08 | 14.36 ±7.74 | 0.72 | 1 |
| | 2 | 18.67** ±1.69 | -0.70 ±1.49 | -1.30 ±3.28 | — | — | — | 4.76 | 3 |
| | 3 | 11.70** ±1.89 | 0.01 ±1.69 | 6.66 ±3.98 | — | — | — | 2.27 | 3 |
| | 4 | 11.16** ±1.70 | 1.96 ±1.76 | 25.04** ±7.44 | — | -4.01 ±7.24 | -24.15** ±7.84 | 0.47 | 1 |

*, **, Significant at P = 0.05 and 0.01 probability levels, respectively.

(a) Cross 1 = Raj 1972 × WH 283, 2 = Kalyansona × Lok 1, 3 = VW 100 × WH 291, 4 = UP 301 × Sonalika.
(+) d.f. = degree of freedom.

providing the test of goodness of fit of the model. There was a considerable change in magnitude of the estimates itself, reduction in standard error of the parameter and change in sign of some of the effects. The change in significance was found to be mainly due to the relative reduction of Cii (error component) term of the inverted matrix.

In the present study it was observed that in majority of cases the estimated parameters and (d) in particular, were smaller than respective standard error or non significantly different from zero. Whenever the (d) or (h) parameters were significant, the contribution of interaction effects was also significant. Under a situation of this type, it would be difficult for the breeder to get promising segregants better than parents through conventional breeding methods such as making simple crosses and their exploitation through straight pedigree method. In order to generate transgrassive segregants, breeding procedures involving multiple crosses, growing large sized populations in each generation and biparental matings in early generations may be resorted to. The use of population improvement concept (Frey, 1975) as an alternative to conventional method may also become amenable solution.

## REFERENCES


Cavalli, L. L. 1952. An analysis of linkage in quantitative inheritance. In Quantitative Inheritance (Eds. E. C. R. Rievs and C. H. Waddington) PP 135-144. HMSO. London.

Frey, K. J. 1975. Breeding concepts and technique for self pollinated crops. Proc. International Workshop on Grain Legumes. ICRISAT Hyderabad. India. PP 252-278.

Jinks, J. L. and R. M. Jones 1958. Estimation of th components of heterosis. *Genetics*, **43** 223-234.

Ketata, H., L. H. Edwards and E. L. Smith 197 Inheritance of eight agronomic characters in winter wheat cross. *Crop. Sci.*, **16** : 19-2

Mather, K. and J. L. Jinks 1971. Biometric Genetics. Chapman and Hall Ltd., London

Mather, K. J. L. Jinks. 1977. Introduction t Biometrical Genetics. Chapman and Ha Ltd., London.

Singh, G., G. S. Bhullar and K. S. Gill. 1984 Inheritance of plant height, days to heading spike length, penducle length and spikelet per spike in a spring wheat cross. *Indian Genet*, **44** : 522-527.

Singh, G., G. S. Nanda and K. S. Gill. 1984 Inheritance of yield and its components i five crosses of spring wheat. *Indian J. agri Sci.*, **54** : 943-949.

Vaghani, J. L. 1985. Gene action and intercharacte association for yield and its attributes i wheat. Unpublished M.Sc. thesis, Gujara Agricultural University, Anand.

AU Res. J. 1990. 15 (2) : 28-31

# Effect of Precision Field Levelling on Irrigation Efficiency and Yield of Wheat

M. Mallik, S. D. Patel, A. R. Patel and S. Raman

Water Management Project, Gujarat Agricultural University, Navsari

## ABSTRACT

An experiment was carried out to find suitable levelling index for growing wheat under border method f irrigation at the research farm of Gujarat Agricultural University Campus, Navsari. The study was onducted for three years with two lengths of border (75 m and 90 m) and three magnitudes of levelling ndex (0 to 1 cm, 2 to 3 cm and 4 to 5 cm). Experimental results revealed that field levelling index should ot be greater than 1 cm and length of border should be between 75 m and 90 m for growing wheat and imilar type of crops in heavy black soils.

*(Received on 3rd Aug. 1987)*

## INTRODUCTION

Irrigation usually plays an important role in gricultural production. Irrigated area benefits reatly from proper levelling since the field in its atural state is seldom suited for the efficient pplication of water by surface method of irrigation. n unlevelled plot, the distribution of water by rface method of irrigation is non-uniform as high pots are watered too little and the low spots too uch. Among the surface methods, border method f irrigation is most prevalent in the command reas. Layout of border is based on conventional ractices which require over-irrigation due to heavy ater losses. Excess irrigation increases the loss of utrients and helps to build up salinity and lkalinity resulting in lower crop production per nit of land and water.

The importance of land levelling for judicious ater management in the canal command areas has een emphasized by Hauston (1966) and Tyagi *et al.* 1979). Johnson *et al.* (1976) have reported that ain yield of wheat improved by 26 per cent in recision levelled fields as compared to traditionally velled field. Kumbhare and Tyagi (1977) in their udy in alkali soils of CSSRI have found that uniform sloping borders resulted in higher grain yield of rice by 10,000 kg/ha and saved 13 per cent water. Agarwal (1981) carried out a study in the sandy loam soil of Hissar research farm and found that wheat grain yield reduced significantly for levelling index value of higher than 2.5 cm. The results also showed that irrigation application, distribution and water use efficiencies were appreciably reduced with increase in levelling index i.e. deterioration in levelling quality.

Admitting the importance of uniform water application, it is necessary to find the optimum magnitude of precision land levelling to economise the cost of this operation which may vary from a few hundred rupees to several thousand rupees per hectare (Pillai and Rege, 1974). The yield is also greatly influenced by uniformity of water application. This happens of variation of available moisture for nutrient uptake and evapotranspiration requirement.

## MATERIALS AND METHODS

Land levelling index quantitatively reflects the precision of the field levelling. It may be defined as the average variation (cm) between designed and

existing field level either before or after the completion of levelling work. Mathematically it is expressed as :

$$\text{Field levelling index (cm)} \quad U = \frac{\text{Differences between the designed and existing grid level (cm)}}{\text{Number of grid points}}$$

A zero value of levelling index indicates that the field is having designed uniform level of slope with no high or low spots throughout the length.

The study was undertaken at the research farm of Gujarat Agricultural University Campus, Navsari for three years in a heavy black soil having pH 7.95, EC 0.37 mmhos/cm, field capacity 32.4%, permanent wilting point 17.2%, clay content 62% and bulk density 1.42 g/cm$^3$ with wheat as test crop. The experiment on levelling index and length of border was laid out with three replications in a randomised block design with two lengths of border (L) namely 75 m and 90 m and three magnitudes of levelling indices (U) namely 0 to 1 cm, 2 to 3 cm and 4 to 5 cm respectively. The plots were irrigated by recommended inflow rate of 1.5 l/s/m width and irrigation interval. Since the general slope of the plot was about 0.3 per cent, only secondary levelling was done by terracing blade and levelling float. The designed magnitude of levelling index in each border was established artificially by repeated earth movement and taking level along the length of border at one metre interval. Inflow rate in each border was measured by Parshall Measuring Flume and flow was continued till it reached the downstream end of the border. The values of advance and recession time at 10 m interval for each irrigation were recorded for different treatments and replications. Soil samples were taken from 15 cm, 30 cm, 45 cm, 60 cm, 75 cm and 90 cm depths at upstream, middle and down stream end of borders just before and after 24 hours of each irrigation. The crop yield and yield attributing characters were recorded and data were analysed statistically.

## RESULTS AND DISCUSSION

### Effect of levelling index on water requirement

After the establishment of desired levelling indices, crop was sown. Two common irrigations each of 6 cm were given at the time of sowing for germination and after 10 days of sowing for establishment. Then the values of levelling indices rechecked but found within the range of treatments level. A little variation of levelling indices might be due to recommended non-erosive inflow rate and limited disturbance of soil for secondary levelling. In addition to two common irrigations, four treatment irrigations (Table 1) were given to each plot at 15 days irrigation interval as per the recommendation of the centre for wheat crop.

It is revealed from the Table 1 that the maximum and minimum depths of total treatment irrigations are 40.61 cm and 27.49 cm respectively. Irrigation requirements increased with higher value of levelling index and border length. There was also some variation of irrigation requirements with years. It might be due to some variation of land preparation and climatic factors. The average irrigation requirements for the treatments of 90 m and 75 m border length with 0 to 1 cm levelling index ($L_2U_1$ and $L_1U_1$) were 28.73 and 28.00 cm respectively. Both the treatments were statistically at par and significantly superior to rest of the treatments. Hence, it is evident that by minor levelling within the plot, about 6 to 14 per cent water can be saved.

### Water application, storage and distribution efficiency

The values of efficiencies for different treatments are given in Table 2. The highest and second highest water application efficiencies of 95 and 92 per cent were for the treatments of 90 m and 75 m border lengths with 0 to 1 cm levelling index respectively. These two treatments gave water storage efficiencies of 82 and 73 per cent respectively. The same two treatments ($L_2U_1$ and $L_1U_1$) also gave highest and second highest water

istribution efficiencies of 84 and 83 per cent espectively. It is also revealed from the table that fficiencies reduced remarkably when the levelling ndex increased from 2 to 3 cm to 4 to 5 cm. This uggests that the values of levelling index should be naintained below 2 to 3 cm for efficient utilization f irrigation water.

### Yield and water use efficiency

Treatmentwise yields for three years and verage values of water use efficiencies are presented in Table 3. The variation of wheat yields (Table 3) for different treatments in three consecutive years were 37.26 to 27.79 q/ha, 27.08 to 22.38 q/ha and 31.32 to 25.93 q/ha respectively. The variation of yields in different years might be due to yearwise variation of climatic factors.

Yearwise and pooled analysis of data (Table 3) revealed that the treatments of 90 m and 75 m border lengths with 0 to 1 cm levelling index ($(L_2U_1$ and $L_1U_1)$ were statistically at par and significantly superior to the rest of the treatments. These two treatments gave highest and second highest average

*TABLE 1*

**Treatmentwise irrigation requirement of wheat for three years and average.**

| *Treatment* | *Irrigation requirement in cm (excluding two common irrigations)* | | | |
|---|---|---|---|---|
| | *1st year* | *2nd year* | *3rd year* | *Average* |
| $(L_1U_1)$ | 27.49 | 28.42 | 28.11 | 28.00 |
| $(L_1U_2)$ | 27.95 | 29.04 | 31.53 | 29.50 |
| $(L_1U_3)$ | 32.54 | 29.44 | 36.68 | 32.88 |
| $(L_2U_1)$ | 27.66 | 28.80 | 29.73 | 28.73 |
| $(L_2U_2)$ | 28.07 | 31.47 | 35.76 | 31.76 |
| $(L_2U_3)$ | 33.17 | 33.43 | 40.61 | 35.73 |

| | S. Em.± (cm) | C. D. at 5% (cm) | C. V. (%) |
|---|---|---|---|
| Treatment | 0.18 | 0.53 | 1.75 |
| Treatment × year | 0.31 | 0.91 | |

a. Length of border, $L_1$ = 75 m and $L_2$ = 90 m

b. Levelling indices, $L_1$ = 0 to 1 cm, $U_2$ = 2 to 3 cm and $U_3$ = 4 to 5 cm

*TABLE 2*

**Average water application, water storage and water distribution efficiencies for different treatments.**

| *Treatment* | *Water application efficiency, %* | *Water storage efficiency, %* | *Water distribution efficiency, %* |
|---|---|---|---|
| $L_1U_1$ | 92 | 73 | 83 |
| $L_1U_2$ | 82 | 65 | 80 |
| $L_1U_3$ | 81 | 87 | 81 |
| $L_2U_1$ | 95 | 82 | 84 |
| $L_2U_2$ | 91 | 68 | 84 |
| $L_2U_3$ | 75 | 84 | 81 |

*TABLE 3*

**Wheat grain yield, total irrigation requirement and water use efficiency for different treatments.**

| *Treatment* | *Wheat grain yield, q/ha* | | | | *Total irrigation requirement, cm* | *Wateruse efficiency, kg/ha cm of water* |
|---|---|---|---|---|---|---|
| | *1st year* | *2nd year* | *3rd year* | *Average* | | |
| $L_1U_1$ | 37.26 | 25.37 | 30.71 | 31.12 | 40.00 | 78 |
| $L_1U_2$ | 34.13 | 23.18 | 27.76 | 28.35 | 41.50 | 68 |
| $L_1U_3$ | 33.47 | 22.38 | 25.93 | 27.27 | 44.88 | 61 |
| $L_2U_1$ | 36.57 | 27.08 | 31.32 | 31.65 | 40.73 | 78 |
| $L_2U_2$ | 30.06 | 24.28 | 29.98 | 27.77 | 43.76 | 63 |
| $L_2U_3$ | 27.79 | 22.93 | 25.98 | 25.58 | 47.73 | 54 |
| S.Em.± | 0.31 | 0.62 | 1.27 | 0.18 | | |
| C.D. at 5% | 0.98 | 1.95 | 4.01 | 0.53 | | |
| C.V.% | 1.63 | 4.43 | 6.54 | 1.75 | | |

* Total irrigation requirement is inclusive of two common irrigations each of 6 cm.

wheat yields of 31.65 and 31.12 q/ha respectively. The same two treatments of 90 m and 75 m border length with 0 to 1 cm levelling index (Table 3) also gave equal but highest wateruse efficiency of 78 kg/ha cm of water.

## REFERENCES


Agarwal, M. C., 1981. Effect of field levelling quality on irrigation efficiency and crop yield. Presented at the XVIII Annual Convention of ISAE held at Karnal.

Hauston Clyde, F., 1966. Trends and cost of land grading for irrigation in California. Trans. *Am. Soc. Agri. Engrs*, 9 (4) : 565-567.

Johnson, III, S. H., Khan, Z. S. and Hussain, Ch.M., 1976. The economics of precision land levelling - a case study from Pakistan. *Agricultural Water Management*, 1 : 319-331.

Kumbhare, P. S. and Tyagi, N. K., 1977. Comparison of improved water management practices with conventional methods of water use and crop yield under the farmer's conditions. C.S.S.R.I. annual report, 174.

Pillai, P. N. B. and Rege, N. D., 1974. Economics of land levelling in irrigation commands. A preliminary study of water management division, Ministry of Agriculture, 27.

Tyagi, N. K., Singh, O. P. and Narayan, V. V. D., 1977. Evaluation of water management system in a tube well irrigated farm. *Agric. Water Management*, 2 : 67-68.

Res. J. 1990. 15 (2) : 32-36

# Effect of Active Lime, FYM and Moisture Regimes on the Yield and P-Zn Composition of Wheat CV GW-120

B. A. Golakiya, M. S. Patel and G. S. Sutaria

Department of Agricultural Chemistry and Soil Science,
Gujarat Agricultural University, Junagadh Campus, Junagadh

## ABSTRACT

A pot experiment was conducted to study effect of soil treatment (FYM, Active lime) on the yield ttributes, yield concentration and uptake of nutrients (P, Zn and Ca) by wheat CV GW-120. Under noisture deplition cycle $M_2$, there was a considerable reduction in the yield attributes,grain (20 %), straw 37 %) yield and the nutrient content and uptake. Application of FYM increased the grain (41 %) and straw (33 %) yield through its positive effect on the yield attributes and content and uptake of P, Zn and Ca by the crop. Active lime ($AL_2$) application reduced the grain (13%) and straw (8 %) yield through its adverse effect on the yield attributes and the accumulation of P, Zn and Ca in the plant (Key words : Moisture, FYM, active lime and wheat).

*(Received on 5th Aug. 1989)*

## INTRODUCTION

More than one third of the world's cultivable oils are calcareous where the problem of nutrient vailability is acute apart from the other ill effects f excess $CaCO_3$ on crop growth (Dahiya and Singh, 982). In such soils availability of phosphorus (P) nd Zinc (Zn) has been limiting and posing serious hreat to successful crop production (Kanzaria and atel, 1985). This experiment was conducted to erive some information on the effect the degree of lcareousness of the soils alongwith the FYM and oisture regimes on the yield, yield attributes and Zn and Ca absorption by the wheat CV GW-120.

## MATERIALS AND METHODS

A pot experiment was conducted on a Vertisol edium black calcareous soil) during winter 1986 h two levels namely, -0.5 ($M_1$) and -1.0 ($M_2$) bar of moisture, two levels namely 0 ($F_0$) and 2 ($F_1$) per cent of FYM and three levels namely, 0 ($AL_0$), 5 ($AL_1$) and 25 ($AL_2$) per cent of active lime of the total 30 per cent lime added in the soil with two replications in a completely randomised factorial design. Some of the soil characteristics are : sand 13.0%, silt 30.3%, clay 56.7%, pH 7.8, EC 0.18 $dSm^{-1}$, $CaCO_3$ 3.3%, CEC 53.0 m.e. 100 $g^{-1}$, exchangeable Ca 44.5 and Mg 6.4 m.e. 100 $g^{-1}$, organic carbon 0.84%, Olsen's P 5.73 ppm $P_2O_5$, available K 172.5 ppm $K_2O$ and DTPA extractable Zn 0.62, Fe 6.53, Cu 3.22 and Mn 11.56 ppm. The polyethylene lined earthen pots (12 liter volume) were filled with 12 kg of the treated soil. Wheat CV GW-120 was sown, which was thinned to nine plants per pot a week after germination. The plant samples were digested in a di-acid mixture as described by Jackson and Ulrich (1969). The acid extract was used for analysis of different nutrients viz. P, Ca and Zn. Phosphorus in the acid extract was determined by vanadomolybdophosphoric yellow colour method, Ca by Versanate method (Jackson, 1958) and Zn by atomic absorption spectrophotometry (Shimadzu Model AA-640-13).

## RESULTS AND DISCUSSION

The results of the effect of moisture, FYM and active lime are set out in tables 1, 2 and 3. Under $M_2$, effective tillers, earhead length and test weight were reduced by 15, 28 and 12 per cent, respectively, over their respective values under $M_1$, which ultimately curtailed the grain yield by 20 per cent under the former. Similarly, the corresponding decrease in the straw yield was by 37 per cent which was due to the corresponding reduction by 15 per cent in the plant height. These results are in conformity with the work of Padmani *et al.* (1976) and Tomar *et al.* (1977) who also reported similar performance of wheat crop under low moisture content.

The addition of FYM application at the rate of 2 per cent significantly augmented the grain and straw yield by 41 and 33 per cent, respectively over that of control. This increase in the yield could be a resultant of 21, 36, 30 and 5 per cent increase in the plant height, effective tillers, earhead length and test weight, respectively, in this treatment over control. These observations support the work reported elsewhere (Singh *et al.*, 1976).

In general, active lime application affected the yield attributes and yield adversely, however, the effect was significant only in case of earhead length, test weight, grain and straw yield, the reduction in these parameters being 8, 2, 13 and 8 per cent, respectively, under $AL_2$ over $AL_0$. Though adverse effect of active lime increased in magnitude with its fineness, it was significant only for the earhead length and grain yield which curtailed marginally under $AL_2$ when compared with $AL_1$. Similar results were also reported for groundnut (Golakia and Patel, 1986); bajara (Verma and Kachroo, 1984).

The concentration of P in the grain and straw was increased significantly by 13 and 41 per cent and that of uptake decreased by 10 and 11 per cent, respectively, under $M_2$ over that of these nutrients under $M_1$, most probably due to the reduced growth and yield under $M_2$. In case of Zn, concentration in the grain and straw significantly reduced by 14 and 19 per cent and that of uptake by 31 and 50 per cent respectively under $M_2$ over $M_1$. The results ar comparable with those reported for P by Saxen (1970) and for Zn by Tiwari *et al.* (1976). Th concentration of Ca in the grain and straw wa reduced significantly under $M_2$, over that under M so also the uptake to the extent of 34 and 72 pe cent, respectively, over $M_1$. Mass flow, the principa mode of Ca transport in the soil (Mengal an Kirkby, 1982) which suffers most unde comparatively low moisture content. This could b the probable reason for the reduced concentratio and uptake of Ca under $M_2$.

As expected, the concentration of P in the grai and straw was raised by 21 and 18 per cent, and s also its uptake by 70 and 75 per cent with FYM application over that under control, respectively Similar findings were reported by More an Ghonsikar (1988). Contrary to the expection, the concentration of Zn in the grain and straw reduce by 13 and 4 per cent, respectively, under FYM application over control. However, this is plainly a result of dilution effect as is evident from the Zn uptake values which were higher to the extent of 23 and 54 per cent in the grain and straw, respectively, in FYM application than those in control. Similarly, the corresponding values of Ca concentration were also decreased slightly but those of uptake were increased to the tune of 36 and 39 per cent.

Active lime diminished the concentration and uptake of P and Zn by the grain and straw. Though differences between P and Zn concentration under $AL_1$ and $AL_2$ in the grain and straw were small, they were statistically significant. The uptake of P by the grain and straw reduced to 21 and 30 per cent under $AL_2$ over $AL_0$, respectively. Abbas *et al.* (1976) also reported reduction in the nutrient composition of pea with increasing active lime content of soil in potted conditions. Significant reduction in the Ca concentration of the grain and straw with increasing levels of active lime is an interesting controversy. We tried to seek the explanation in content of the exchangeable Ca content in the soil and lime in the soil which were 44 and 3.0 me 100 $g^{-1}$, respectively. Thus, the soil was more potent source of available Ca rather than sparingly soluble active lime itself. This is how the application of active lime reduced the Ca content in the plant. The reduction in the uptake of Ca by the grain and straw is attributed to reduced growth and yield of the crop.

TABLE 1
Mean effect of moisture, FYM and active lime on yield attributes and yield of wheat CV GW-120.

| Treatments and levels | Plant height (cm) | Effective tillers | Earhead length (cm) | Test weight (g) | Grain yield (g pot$^{-1}$) | Straw yield (g pot$^{-1}$) |
|---|---|---|---|---|---|---|
| $M_1$ | 49.59 | 18.01 | 6.70 | 42.00 | 14.52 | 35.45 |
| $M_2$ | 42.31 | 15.24 | 4.80 | 37.09 | 11.63 | 22.39 |
| CD (0.05) | 4.09 | 1.73 | 0.14 | 0.41 | 1.22 | 6.47 |
| $F_0$ | 41.61 | 14.08 | 5.00 | 38.60 | 11.02 | 29.32 |
| $F_1$ | 50.29 | 19.17 | 6.50 | 40.49 | 15.53 | 34.53 |
| CD (0.05) | 4.09 | 1.73 | 0.14 | 0.41 | 1.22 | 6.47 |
| $AL_0$ | 48.75 | 16.95 | 5.96 | 39.96 | 14.11 | 30.42 |
| $AL_1$ | 44.85 | 16.45 | 5.78 | 39.40 | 12.84 | 28.44 |
| $AL_2$ | 44.26 | 16.48 | 5.50 | 39.27 | 12.28 | 27.91 |
| CD (0.05) | NS | NS | 0.16 | 0.50 | 0.27 | 0.58 |

TABLE 2
Mean effect of moisture, FYM and active lime on the concentration and uptake of phosphorus by wheat CV GW-120.

| Treatments and levels | P concentration (mg g$^{-1}$) | | P uptake (mg pot g$^{-1}$) | |
|---|---|---|---|---|
| | Grain | Straw | Grain | Straw |
| $M_1$ | 4.45 | 0.74 | 74.61 | 26.23 |
| $M_2$ | 5.02 | 1.04 | 58.38 | 23.28 |
| CD (0.05) | 0.34 | 0.28 | 8.3 | 2.10 |
| $F_0$ | 4.29 | 0.82 | 47.27 | 19.12 |
| $F_1$ | 5.18 | 0.97 | 80.44 | 33.49 |
| CD (0.05) | 0.34 | 0.28 | 8.3 | 2.10 |
| $AL_0$ | 4.89 | 1.03 | 68.99 | 31.33 |
| $AL_1$ | 4.85 | 0.86 | 62.27 | 24.46 |
| $AL_2$ | 4.45 | 0.79 | 54.64 | 22.04 |
| CD (0.05) | 0.41 | 0.34 | 10.16 | 4.41 |

*TABLE 3*

**Mean effect of moisture, FYM and active lime on the concentration and uptake of zinc and calcium by wheat CV GW-120.**

| *Treatment and levels* | *Zn concentration (μg g⁻¹)* | | *Zn uptake (μg pot⁻¹)* | | *Ca concentration (mg g⁻¹)* | | *Ca uptake (mg pot⁻¹)* | |
|---|---|---|---|---|---|---|---|---|
| | *Grain* | *Straw* | *Grain* | *Straw* | *Grain* | *Straw* | *Grain* | *Straw* |
| $M_1$ | 73.83 | 64.08 | 1072 | 2307 | 1.7 | 3.19 | 16.98 | 113.08 |
| $M_2$ | 63.55 | 51.96 | 739 | 1163 | 0.97 | 3.13 | 11.28 | 72.32 |
| CD (0.05) | 1.23 | 1.14 | 117 | 117 | 0.02 | 0.02 | 1.40 | NS |
| $F_0$ | 73.41 | 56.83 | 808 | 1325 | 1.09 | 3.31 | 12.01 | 77.19 |
| $F_1$ | 63.97 | 59.22 | 993 | 2044 | 1.05 | 3.10 | 16.30 | 107.04 |
| CD (0.05) | 1.23 | 1.14 | 117 | 117 | 0.02 | 0.02 | 1.40 | NS |
| $AL_0$ | 69.94 | 60.34 | 986 | 1835 | 1.14 | 3.26 | 16.08 | 99.16 |
| $AL_1$ | 67.43 | 58.94 | 865 | 1176 | 1.05 | 3.25 | 13.48 | 92.43 |
| $AL_2$ | 68.69 | 54.79 | 843 | 1529 | 1.03 | 3.11 | 12.64 | 86.80 |
| CD (0.05) | 1.28 | 1.17 | 120 | 121 | 0.03 | 0.02 | 1.48 | NS |

## REFERENCES


bbas, R.; El-Dien, Y. V. and EL-Basioni, S. M. (1976). Effect of calcium carbonate fineness on plant growth and nutrient content of maize and cowpea plants in calcareous soil. *Agril. Research Review*, **54**, : 37-41.

ahiya, S. S. and Singh, R. (1982). Effect of soil application of $CaCO_3$ and Fe on dry matter yield and nutrient uptake in oats. *Pl. Soil* **65** : 79-86.

olakiya, B. A. and Patel, M. S. (1986). Effect of calcium and boron application on yield and yield components in groundnut. *Indian J. Pl. Physiol.*, **29**, 28-33.

ıckson, M. L. (1958). *Soil chemical analysis*, Prentice Hall Inc. Englewood, Chiffs.

ıckson, M. L. and Ulrich, A. (1969). Analytical methods for use in plant analysis, California Agric. Exp. Stn. Bull. 766.

anzaria, M. V. and Patel, M. S. (1985). Soils of Gujarat and their management. In "Soils of India and their Management Pub Fertilizer Association" of India New Delhi pp. 103-129.

Mengal, K. and Kirkby, E. A. (1982). "*Principles of plant nutrition*" International Potash Institute, Worblauten Bern, 434-457.

More, S. D. and Ghonsikar, C. P. (1988). Effect of some organic manures on the availability of phosphorus to wheat. *J. Indian Soc. Soil Sci.*, **36**, 372-374.

Padmani, D. R.; Motwani, V. T. and Patel, J. C. (1976). Notes on effect of time of irrigation and nitrogen on yield of wheat J-1-7. *GAU Res. J.* **2** : 65-66.

Saxena, M. C. (1970). Studies on the availability of soil and fertilizer phosphorus as affected by moisture and fertilizer supply. *Soil Sci. Soc. Am. Proc.*, **33**, 614-618.

Singh, Y. P.; Singh, D. R. and Sharma, B. B. (1976). Effect of organic manuring on the yield attributes and yield of wheat crop. *Indian J. Agron.*, **21**, 95-98.

Tiwari, K. N.; Pathak, A. N. and Upadhyay, R. L. (1976). Studies on Fe and Zn nutrition of rice at varying moisture regimes in black clay soils of U.P. *J. Indian Soc. Soil Sci.*, **24**, 303-307.

Tomar, S. P.; Singh, U. B. and Rathi, R. S. (1977). Wheat production as influenced by moisture regimes and fertility levels. *Indian J. Agron.* **22**, 166-169.

Verma, S. S. and Kachroo, A. (1984). Effect of added phosphate and yield of pearlmillet in presence of calcium carbonate and farmyard manure. *J. Indian Soc. Soil Sci.*, **32**, 684-689.

GAU Res. J. 1986, 15 (2) : 37-42

# A Comparative Study of Costs and Returns for Different Categories of Milk Producers in Surat City

Darsi V. S. Rao and G. D. Parmar

Department of Agril. Economics, N. M. College of Agriculture, GAU, Navsari Campus, Navsari

## ABSTRACT

The producers supplying milk to consumers and traditional middlemen (Category-I) had competetiveness to pull on their business, while the other group to certain extent had withstood though not totally because of negative returns. The average cost of buffaloe's milk per animal per year accounted to Rs.5,866.98. It was higher (Rs. 6214.68) in category-I as compared to category-II (Rs. 5614.44). The per litre cost of production increases with increase in farm size and it was higher in category-I as compared to category-II. All the farm size groups in category-I were operating profitably. The small and medium size farm groups of category-II covered only Cost-A and Cost-B whereas in the large size farms groups even Cost-$A_1$ was not covered.

*(Received on 6th Sept. 1986)*

## INTRODUCTION

The dynamic situation in the country has increased the importance for studies on costs and returns pattern in milk production. These studies are in immediate need in all the states to have a rational pricing policy. From the policy point of view, the costs and returns structure on dairy farms is an important aspect for the producers, consumers and policy makers. To keep the producers in production, the remunerative price for their product based on cost of production is also an important criterion. Therefore, the price of milk based on production costs is an important factor in influencing the level of milk production and income of producers. The present study was undertaken with the following objectives :

(i) To study the costs and returns in urban milk production per animal per year in different dairy farm size groups and for different categories of milk producers. (ii) To study the costs and returns pattern per litre of milk production for different categories of milk producers and in different dairy farm size groups.

## MATERIALS AND METHODS

The present investigation on costs and returns of urban milk production was carried out in Surat City. The sample consists of 60 buffaloe's milk producers of Surat Milk Producers Co-operative Union, Surat City. These milk producers were categorised into two categories based on milk sales to different agencies. The first category (Category-I) consists of producers selling milk to middlemen and consumer's, the second category (Category-II) consists of producers selling milk to co-operative society. The first category consists of 25 sampled producers and second category 35 sampled producers.

The samples producers were also grouped into three groups in each category, based on the number of animals with each producer. Group-I consists of small size farm group (having less than 30 animals) Group-II consists of medium size farm group (having 30-60 animals) and Group-III is large size farm group (having more than 60 animals). The costs and returns were estimated for groupwise and also categorywise. The data was collected for the year 1980 by personal interview method with the help of well designed survey schedules.

### Costs Estimation

The cost of production of milk is worked out according to the cost concepts given below :

(I) Cost-$A_1$ :
It includes, value of green fodder, dry fodder, concentrates, paid labour, depreciation on animals, sheds and equipment, veterinary and medical charges, water, electricity and repairing charges and interest on working capital.

(II) Cost-$A_2$ :
Cost-$A_1$ + rent paid for leased in sheds.

(III) Cost-B :
Cost-$A_2$ + interest on fixed capital invested.

(IV) Cost-C :
Cost-B + imputed value of family labour.

(V) Net Cost = Gross Cost - Value of dung.

### Income Estimation

Income over different costs is worked out as under :

(I) Gross income :
It includes the income realised from the sales of milk and the value of dung.

(II) Farm business income :
Gross Value of output - Cost-$A_1$

(III) Return to family labour :
Gross Value of output - Cost-B.

(IV) Net returns :

## RESULTS AND DISCUSSION

### Costs Estimation

The different types of costs are worked out per animal per year for different size farms and for different categories of milk producers (Table-1). The data in the table show that on an average Cost-$A_1$ per animal per year was Rs.5208.18 for over all the size groups. Cost-$A_1$ was higher in Category-I, i.e. Rs.5,544.90 and lower in Category-II i.e. Rs.4,959.30 per animal per year. It was greater in small size farm group of Category-I as compared to the rest of the groups i.e. Rs.5,612.40 and lower in small size farms of Category-II (Rs.4,813.20). In the present study Cost-$A_2$ was not studied because the shed were owned by the producers themselves and hence no rented dairy sheds were present. Therefore Cost-B was estimated directly after Cost-$A_1$.

Cost-B was higher in large size farm group (Rs.5,954.82) and lower on medium size farm group (Rs.5,621.76). Cost-B accounted to Rs. 6,024.36 in Category-I and Rs.5,449.74 in Category-II per year. Cost-B was also greater in small size farm group of Category-I. All the farm size groups of Category-I had higher expenditure on Cost-B as compared to the farm size groups of Category-II.

Irrespective of the farm size group and Categories, the average total cost (Cost-C) per animal per year accounted to Rs. 5,886.98. The Cost-C for different farm size groups in Category-I and II show that it was higher in small size farm group of Category-I and lower in medium size farm group of Category-II. In Category-II the large size farm group had higher cost of maintenance than rest of the groups. The higher total cost of maintenance was due to higher expenditure incurred on feeding and also slightly higher capital investment than rest of the groups.

The per litre cost of production for different farm size groups showed positive relationship with farm size (Table-1) i.e. with increase in farm size, the per litre cost of production increased. Large size farm group of Category-II had higher cost of production per litre (Rs. 3.23) followed by small size farm group of Category-I (Rs. 3.01). In case of Cost-A and Cost-B, the same groups had high values respectively. Low cost of production per litre was observed in small size farm group of Category-II for all types of costs.

### Returns over different types of costs

The returns over different types of costs viz., Cost-$A_1$, Cost-B and Cost-C for different categories of producers and for different farm size groups are presented per animal per year and per litre of milk production in Table-3. The returns over different costs indicated that all the farm size groups in Category-I, were operating profitably. Net returns were more in large size farm group of Category-I (Rs. 366.73). In small and medium size farm groups of Category-II upto Cost-$A_1$ and Cost-B were covered though Cost-C was not covered. While in large size farm group of Category-II even Cost-$A_1$

*TABLE 1*

**Cost of maintenance in different farm size groups for different categories of milk producers (1980).**

**(Amount in Rs.)**

| *Category* | *Category-I* | | | *Category-II* | | | *Overall* | | |
|---|---|---|---|---|---|---|---|---|---|
| *Farm size group* | *Cost-$A_1$* | *Cost-B* | *Cost-C* | *Cost-$A_1$* | *Cost-B* | *Cost-C* | *Cost-$A_1$* | *Cost-B* | *Cost-C* |
| **Per animal per year :** | | | | | | | | | |
| Small | 5612.40 | 6081.29 | 6356.20 | 4813.20 | 5295.10 | 5513.79 | 5156.94 | 5632.74 | 5866.98 |
| Medium | 5523.60 | 5982.76 | 6163.44 | 4873.29 | 5358.69 | 5512.64 | 5145.96 | 5612.76 | 5782.80 |
| Large | 5500.24 | 6002.46 | 6149.53 | 5427.25 | 5922.40 | 6021.74 | 5457.06 | 5954.82 | 6071.94 |
| Over all groups | 5544.90 | 6024.36 | 6214.68 | 4959.30 | 5449.74 | 5614.44 | 5208.18 | 5687.64 | 5866.98 |
| **Per litre .** | | | | | | | | | |
| Small | 2.66 | 2.88 | 3.01 | 2.24 | 2.46 | 2.56 | 2.42 | 2.64 | 2.75 |
| Medium | 2.50 | 2.72 | 2.80 | 2.28 | 2.50 | 2.58 | 2.45 | 2.68 | 2.76 |
| Large | 2.62 | 2.85 | 2.92 | 2.91 | 3.17 | 3.23 | 2.78 | 3.03 | 3.09 |
| Over all groups | 2.67 | 2.90 | 2.99 | 2.37 | 2.61 | 2.69 | 2.50 | 2.73 | 2.82 |

Source : Field Survey.

was not covered. Thus, it was clearly evident that due to higher cost of production in large size farm group of Category-II even Cost-$A_1$ was not covered while in small and medium size farm groups due to low cost of milk production Cost-$A_1$ and Cost-B were covered to certain extent. The returns per litre of production also indicated the same pattern.

It was clear from the above discussion that the producers supplying milk to consumers and traditional middlemen (Category-I) had competitiveness to pull on their bussiness, while the other group to certain extent had withstood though not totally because of negative returns. It was interesting to note here the recommendations of National Commission on Agriculture (1976) which will be helpful to certain extent to understand the role of costs and returns structure in organised dairy sector. In the opinion of the Commission, "the purchase and selling prices of milk in the organised sector for milk and milk products have also often not been competitive with those of traditional sector. Organisation and modernisation of dairying have only added to the cost of marketing milk rather than increasing productivity, therefore, the competitiveness. In short, it can be stated that the pricing problems of organised dairying sector stem primily from the fact that its prices have not stimulated productivity".

The long extract from the report of the commission points out that the prices of milk in organised dairy sector were neither competitive with traditional sector nor they stimulated productivity. Hence the prices of organised sector should be competitive with others selling prices of milk, a necessary condition for its success. The findings of the present study also emphasises the same, that due to price differentiation existed between the co-operative society and other traditional middlemen, the producers supplying milk to the former may not be competitive with the producers supplying milk to the later. Further analysis of correlation co-efficients also support these findings. The presence of traditional middlemen and producers selling milk directly to the consumers is a common factor in our urban demand centres.

*TABLE 2*

**Gross income in different farm size groups for different categories of producers (1980).**

**(in Rupees)**

| *Group* | *Category-I* | *Category-II* | *Overall categories* |
|---|---|---|---|
| **Per animal per year :** | | | |
| Small | 6481.45 | 5408.25 | 5873.42 |
| Medium | 6240.63 | 5386.60 | 5780.65 |
| Large | 6516.26 | 4771.59 | 5455.15 |
| Overall groups | 6401.34 | 5263.08 | 5760.84 |
| **Per litre :** | | | |
| Small | 3.07 | 2.52 | 2.75 |
| Medium | 2.84 | 2.52 | 2.76 |
| Large | 3.09 | 2.56 | 2.78 |
| Overall groups | 3.08 | 2.52 | 2.76 |

Note : Gross income estimated at Rs.3.00 per litre of milk and Rs.2.44 per litre for category I and II respectively.

Source : Field Survey.

TABLE 3

**Returns over different costs in different farm size groups for different categories of producers.**

**(Amount in Rs.)**

| *Category* | *Category-I* | | | *Category-II* | | | *Overall* | | |
|---|---|---|---|---|---|---|---|---|---|
| *Farm size groups* | *Returns over Cost-$A_1$* | *Returns over Cost-B* | *Returns over Cost-C* | *Returns over Cost-$A_1$* | *Returns over Cost-B* | *Returns over Cost-C* | *Returns over Cost-$A_1$* | *Returns over Cost-B* | *Returns over Cost-C* |
| **Per animal per year :** | | | | | | | | | |
| Small | 869.05 | 400.16 | 125.25 | 595.05 | 113.15 | -105.44 | 716.48 | 240.68 | 6.44 |
| Medium | 717.03 | 257.80 | 77.19 | 513.31 | 27.91 | -126.04 | 634.69 | 167.89 | -2.15 |
| Large | 1016.02 | 513.80 | 366.73 | -655.66 | -1150.81 | -1250.15 | -1.91 | -499.67 | -616.70 |
| Overall | 856.44 | 376.98 | 186.66 | 303.78 | -186.66 | -351.36 | 552.66 | 73.20 | -106.14 |
| **Per litre :** | | | | | | | | | |
| Small | 0.41 | 0.19 | 0.06 | 0.27 | 0.05 | -0.04 | 0.33 | 0.11 | 0.00 |
| Medium | 0.32 | 0.12 | 0.04 | 0.24 | 0.01 | -0.06 | 0.31 | 0.08 | 0.00 |
| Large | 0.48 | 0.24 | 0.17 | -0.35 | -0.62 | -0.67 | 0.00 | -0.25 | -0.31 |
| Overall | 0.41 | 0.18 | 0.09 | -0.15 | -0.09 | -0.17 | 0.26 | -0.03 | -0.06 |

Source : Field Survey.

ABLE 4

eld, income and returns per animal per day in different categories of producers (1980).

(Amount in Rs.)

| Sr. No. | Item | Category-I | Category-II | Overall the Categories |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 1. | Average milk yield (Litres) | 5.67 | 5.70 | 5.69 |
| 2. | Income from milk (Rs.) | 17.02 | 13.90 | 15.25 |
| 3. | Income from dung (Rs.) | 0.47 | 0.48 | 0.49 |
| 4. | Gross Income (Rs.) | 17.49 | 14.38 | 15.74 |
| 5. | Cost-C (total cost) (Rs.) | 16.98 | 15.34 | 16.03 |
| 6. | Net Cost (Rs.) | 16.51 | 14.86 | 15.54 |
| 7. | Net returns | 0.51 | -0.96 | -0.29 |
| 8. | Return from milk (excluding income from dung) | 0.04 | -1.44 | -0.78 |

The values of 'r' between size of dairy farm and ross cost, per litre cost of milk, gross income and et income were +0.0694; +0.0533; -0.1311 and 0.0619. These calculated values of 'r' were onsignificant at both 5 per cent and 1 per cent evels. Thus it can be concluded that the dairy farms elonging to any size were equally influenced by ross cost, per litre cost of milk, gross income and t income to the milk producers of the both tegories. The mean differences tested with 't' test vere also expressed non-significantly. It was also bserved that the gross income of two categories of nilk producers were significantly differed at 1 per nt level with Rs.17.49 paise per animal per day for tegory-I and Rs.14.38 for category-II (Table-4). It vas clear from the above discussion that the roducers supplying milk directly to dairy (category-I) can not with stand the competitiveness of the roducers of category-I due to the negative net eturn to them, while the producers belonging to the Category-II, who had positive net return can easily ull on with their business.

## REFERENCES


Chahal, T. S. and J. S. Chawla, (1975). Economics of Milk Production of Different Dairy Farms in Amritsar City, *Indian J. Agril. Econ.* **XXX**(3) : 157.

Madalia, V. K. and A. S. Charan, (1976). Economics of Maintenance of Cows and Buffaloes and their Milk Production, *Financing Agriculture*, **VIII**(1) : 26-31.

Singh, Balwant. *et al.* (1980). A Study into the Comparative Economics of Milk Production in Urban and Rural Areas of Punjab State, *Indian J. Agril. Econ.* **XXXV**(4) : 156.

Singh, Balwinder, (1980). Economics of Milk Production in the Urban Area of Punjab with Special Reference to Ludhiana City. *Indian J. Agril. Econ.* **XXXV**(4) : 158.

Singh, T. R. and C. Singh, (1980). A Comparative Economics of Milk Production on Government and Private Dairy Farms in District Kanpur. *Indian J. Agril. Econ.* **XXXV**(4) : 157.

GAU Res. J. 1990. 15 (2) : 43-45

# Short Communications

## Nutrient and Spacing Management in Mustard

H. V. Kharodia, A. T. Patel

Regional Research Station,
Gujarat Agricultural University,
Sardar Krushinagar

An experiment was conducted to study the effect of various levels of nitrogen, phosphorous and spacing on yield and quality of mustard variety 'Varuna' at seed technology centre Department of Gujarat Agricultural University, Sardar Krushinagar during rabi, 1982-83. The soils was loamy sand in texture, low in organic matter, available nitrogen and phosphorous and moderate in available potash. The experiment was laid out in split-plot design with spacing in main plot treatments and nitrogen and phosphorous levels as sub plot treatments. In all, thirty six combinations comprising three levels of spacing (30, 45 and 60 cm), four levels of nitrogen (25, 50, 75 and 100 kg/ha) and three levels of phosphorous (0, 25 and 50 kg/ha) with four replications under irrigated conditions. The entire dose of phosphorous and half of nitrogen were applied as per treatments 6 to 8 cm deep in furrow just before sowing. The remaining dose of nitrogen was applied at flowering stage. The results are presented in Table-1.

### Effect of row spacing

It is evident from Table-1 that there was significant effect of row spacing on seed yield. The highest yield of 2036 kg/ha was secured with 60 cm row spacing which was 7.0 and 10.9 per cent higher than those of 45 and 30 cm row spacing, respectively. Row spacing of 60 cm resulted in higher plant height, number of primary and secondary branches per plant, number of pods per plant, seed yield per plant and test weight of seeds indicating better growth and development of individual plant. Thus mustard variety varuna on account of its branching characteristics appeared to require 60 cm row spacing to provide maximum yield. These results are in conformity with those of Patel *et al.*, (1980) and anonymous (1980). The row spacing of 45 cm gave a marginal but significant higher oil content in mustard seeds than those of 60 and 30 cm spacings.

### Effect of nitrogen

Application of graded doses of nitrogen was found to be advantageous in boostingup the seed yield of mustard. It is evident from Table-1 that application of nitrogen at 100 kg/ha gave significantly higher yield than the rest of the lower levels recording 2205 kg/ha. The increase in seed yield over those of 25, 50 and 75 kg/ha was to the tune of 38.1, 18.4 and 8.4 per cent, respectively. The highest seed yield obtained under the treatment, 100 kg N/ha can be attributed to higher number of primary and secondary branches per plant and number of pods per plant which were found to positively correlate with seed yield. The contribution of pods per plant was as high as 96.0 per cent in increasing the seed yield of mustard. The results are in agreement with studies conducted by Ghosh and Gupta (1975), Suraj Bhan (1979) and Bishnai and Kumar (1979). Application of nitrogen at 50 kg/ha gave the highest oil content of 41.04 per cent which was 0.88, 1.91 and 3.66 per cent higher than that obtained with 25, 75 and 100 kg N/ha, respectively.

### Effect of phosphorous

The maximum seed yield of 2075 kg/ha was recorded under the treatment involving 50 kg $P_2O_5$/ha. The increase in seed yield at 50 kg $P_2O_5$/ha, was by 6.01 and 19.18 per cent over those of 25 and 0 kg $P_2O_5$/ha, respectively. The beneficial effect was also exhibited in primary and secondary branches per plant, number of pods per plant, number of seeds per pod and test weight with application of 50 kg $P_2O_5$/ha. The findings are in concurrence with those reported by Suraj Bhan *et. al.*, (1975) and Sinha and Sinha (1979). The oil content in the mustard seed increased significantly with increase in levels of phosphorous. The highest oil content of 40.82 per cent was recorded under the

*TABLE 1*

**Influence of different row-spacings, nitrogen and phosphorous levels on mustard.**

| *Treatment* | *Plant height (cm) at harvest* | *Primary branches per plant* | *Secondary branches per plant* | *No.of pods per plant* | *No.of seeds per pod* | *Weight of 1000 seeds (g)* | *Seed yield per plant (g)* | *Seed yield kg/ha* | *Stover yield kg/ha* | *Oil content of seeds (%)* | *Net realization (Rs/ha)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* |
| **Row spacing (cm)** | | | | | | | | | | | |
| 30 | 182.8 | 5.17 | 9.20 | 147 | 11.9 | 5.46 | 9.04 | 1836 | 2572 | 40.1 | 5895.24 |
| 45 | 188.0 | 5.39 | 11.06 | 209 | 12.1 | 5.59 | 13.55 | 1903 | 2689 | 40.9 | 6208.29 |
| 60 | 191.4 | 5.60 | 11.68 | 287 | 12.2 | 5.66 | 18.32 | 2036 | 2890 | 40.1 | 6813.66 |
| C. D. at 5% | 2.5 | 0.15 | 0.61 | 13 | NS | 0.11 | 0.78 | 121 | 157 | 0.2 | — |
| **N levels (kg/ha)** | | | | | | | | | | | |
| 25 | 184.7 | 4.71 | 8.30 | 182 | 11.8 | 5.47 | 11.16 | 1597 | 2399 | 40.7 | 5028.83 |
| 50 | 188.9 | 5.42 | 10.83 | 211 | 11.9 | 5.51 | 13.19 | 1863 | 2689 | 41.0 | 6093.20 |
| 75 | 187.9 | 5.57 | 11.33 | 229 | 12.3 | 5.54 | 14.47 | 2034 | 2864 | 40.3 | 6730.33 |
| 100 | 188.2 | 5.84 | 12.13 | 234 | 12.4 | 5.76 | 15.72 | 2206 | 2917 | 39.6 | 7370.52 |
| C. D. at 5% | 2.5 | 0.18 | 0.47 | 11 | NS | 0.13 | 0.64 | 99 | 30 | 0.4 | — |
| **$P_2O_5$ levels (kg/ha)** | | | | | | | | | | | |
| 0 | 189.0 | 5.12 | 8.82 | 202 | 11.9 | 5.44 | 12.30 | 1741 | 2683 | 40.0 | 5630.72 |
| 25 | 186.0 | 5.45 | 10.74 | 214 | 12.1 | 5.53 | 13.90 | 1957 | 2708 | 40.3 | 6451.81 |
| 50 | 187.3 | 5.60 | 12.38 | 226 | 12.2 | 5.74 | 14.70 | 2075 | 2760 | 40.8 | 6828.52 |
| C. D. at 5% | 2.2 | 0.15 | 0.41 | 9 | NS | 0.11 | 0.55 | 86 | NS | 0.3 | — |
| Sig. interactions | — | NXP | SXN SXP | SXNXP | — | — | — | — | — | SXN | — |

treatment involving 50 kg $P_2O_5$/ha which was 2.02 and 1.16 per cent higher than that obtained with 0 and 25 kg $P_2O_5$/ha respectively. These results are in accordance with those reported by Vanjaria (1977) and Patel *et al.*, (1980).

Interactions N × P for primary branches per plant, S × N and S × P for secondary branches and S × N × P for number of pods per plant were significant.

The correlation coefficients of primary branches/plant, secondary branches/plant, pods/plant and plant height with seed yield/plant was positive and significant. Pods/plant were found to have highest positive correlation with seed yield/plant. The number of branches and subsequently pods/plant would be influenced by spacing as well as nutrient status and thereby effect the seed yield/plant. Row spacing of 60 cm, N rate of 100 kg/ha and P rate of 50 kg/ha were found to be advantageous not only in their individual capacity but they interacted synergestically too.

Economics of treatments in terms of net realization (Rs/ha) is presented in Table-1. The perusal of the table revealed that highest returns were obtained with 100 kg N/ha followed by 50 kg $P_2O_5$/ha and 60 cm spacing as main treatments. In combination also 100 kg N and 50 kg $P_2O_5$/ha at 60 cm spacing recorded the highest return of Rs.8786/ha.

Thus the experimental results indicated that inter-row spacing of 60 cm with application of 100 kg N/ha and 50 kg $P_2O_5$/ha may be considered for growing mustard variety varuna in light soils of North Gujarat for obtaining higher seed yield and monetary gains.

*(Received on 8th March, 1988)*

## REFERENCES

Anonymous, (1980). Plant population-cum spacing cum fertilizers experiment on mustard varuna at Sardar Krushinagar. Annual Research Report of oilseeds crop, Gujarat Agri. Uni., Junagadh p.54.

Bishnai, K. C. and Singh, K. (1979). Effect of sowing dates, varieties and nitrogen levels on yield and yield attributes of Raya. *Indian J. Agron.* 24 (2) : 123-129.

Ghosh, J and Gupta, D. S. K. (1975). Response of new released mustard variety T-59 *Brassica juncea* (035) to high doses of nitrogen and date of sowing under mid winter conditions of *West Bengal Oilseeds J. (Telhan Patrika)*, 5(1) : 16-18.

Patel, K. A., Parmar, M. T. and Patel, J. C. (1980). Response of mustard of different spacing and levels of nitrogen and phosphorous. *Indian J. Agron.* 26(3) : 524-535.

Sinha, N. P., and Sinha V. P. (1979). Effect of different levels of nitrogen, phosphorous and potash on yield and quality of *Brassica Campetris* var. Yellow sarson. *Rajendra Agri.Uni.J.Res.* 2(17) : 67-69.

Suraj Bhan (1979). Effect of soil moisture and nitrogen on mustard under gangatic Alluvine of U.P. *Indian J. Agron.* 24(2) : 180-186.

Suraj Bhan, Singh, H. G. and Singh, A. (1975). Note on effect of variety spacing and fertility levels on yield and ancillary characters of mustard. *Indian J.Agric.Res.* 9(4) : 208-10.

Vanjaria, N. K. (1977). Effect of sowing time and phosphorous on the growth and yield of mustard *(Brassica juncea* (L) (zern and coss) var. Patan mustard-67. Thesis submitted to GAU in partial fulfilment of the requirements for degree of M. Sc. (Agri.), Agronomy.

GAU Res. J. 1990. 15 (2) : 46-48

# Effect of Irrigation Timing and Isoproturon Application on Weeds and Yield of Isabgul (*Plantago ovata* Forsk)

**P. H. Patel and H. M. Mehta**

Department of Agronomy,
B. A. College of Agriculture, Anand

*Isabgul* is one of the very few medicinal crops cultivated in the country. The area and production *isabgul* in the Gujarat State during the year 86 were 26900 ha and 18800 t, respectively. broadcast sown crop, *isabgul* can not be intercultured hence, hand weeding is the mainstay for weed control which is not only costly but availability of labourers in time is a baffling problem as well. Under such conditions, chemical weed control has been suggested to be better. Farmers in North Gujarat was isoproturon for weed control in isabgul. However, at number of instances they do not get proper weed control probably due to non synchronization between irrigation timing and isoproturon application. Since, soil moisture influences on the activity of isoproturon against weeds (Blair, 1985), it was deemed useful to study the relationship.

The field experiment was conducted during *rabi* season of the year 1985-86 at the College Agronomy farm, Gujarat Agricultural University, Anand, on loamy sand soil, with a pH of 7.8, in split plot design with four replications. The eight irrigation timings viz., irrigation at 10 DBS (isoproturon 7 DBS), (isoproturon 3 DBS), at the same day of sowing (isoproturon on the same day), at same day of sowing (isoproturon 2 DAS), at same day of sowing (isoproturon 3 DAS), at 10 DAS isoproturon 10 DAS), at 20 DAS (isoproturon 20 DAS) and at 20 DAS (isoproturon-urea mixture) were relegated to main plot while weed management treatments viz., isoproturon at 0.5 kg/ha and 1.0 kg/ha, had weeding twice and unweeded control were taken as sub-plot treatments. Thus pre-sowing, pre-emergence and post emergence applications of isoproturon were tested along with irrigation timings in *isabgul*. The crop was fertilized at the rate of 25 kg/ha in the form of urea keeping seed rate at 4 kg/ha. After giving light irrigation for germination subsequent irrigations to each treatments were given at 45 to 40 per cent available soil moisture depletion estimated gravimetrically.

The results on dry weight of weeds (Table 1) indicated that differences due to weed management were significant. Hand weeding significantly reduced the dry weight of weeds which was to the tune of 97.5 per cent as compared to unweeded control. It was observed that when isoproturon was sprayed on the established population of *C. album*, has controlled the weed, however when mixed with urea, due to bouncing of urea granules, the killing effect was comparatively very less. In this treatment the quantity of isoproturon (0.5 and 1.0 kg) was throughly mixed with urea (15 kg/ha) which form a dressing of isoproturon film on urea granules at the time of application.

From the present study it was revealed that isoproturon at the rate of 0.5 kg/ha was the threshold level, comparable with and weeding. Hand weeding significantly increased seed yield of *isabgul*. The increase was attributed to effective control of *C. album* upto maturity stage along with other weeds like *chenopodium album* L., *Argemone mexicana* L. and *cynodon dactylon* pers which provided increased straw yield. Findings are in agreement with Mehta *et al.* (1985) who indicated that three hand weedings gave seed yield of *plantago ovata* similar to the application of 0.5 kg/ha isoproturon as pre-sowing or pre-emergence. Higher rate (1.0 kg/ha) of herbicide was found phytotoxic and reduced the yield of crop. Among various interactions, the combination of irrigation immediately after sowing with hand weeding ($I_1H_3$) significantly increased seed yield but considering the

TABLE 1

**Effect of irrigation timing and weed management on dry weed biomass and seed yield of *isabgul* at harvest (kg/ha).**

| *Irrigation* | *Seed yield* | | | | | *Dry weight of weeds* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $H_1$(0.5) | $H_2$(1.0) | $H_3$(HW) | $H_4$(UWC) | *Mean* | $H_1$(0.5) | $H_2$(1.0) | $H_3$(HW) | $H_4$(UWC) | *Mean* |
| $I_1$ - 10 DBS | 1188 | 1219 | 1469 | 214 | 1022 | 720 | 264 | 78 | 1997 | 765 |
| $I_2$ - 6 DBS | 1492 | 1352 | 1688 | 138 | 1167 | 511 | 200 | 44 | 1820 | 644 |
| $I_3$ - Same day | 1578 | 1383 | 1766 | 110 | 1209 | 270 | 128 | 44 | 1794 | 559 |
| $I_4$ - Same day | 1422 | 1328 | 1422 | 74 | 1062 | 144 | 131 | 34 | 2033 | 586 |
| $I_5$ - Same day | 1571 | 1110 | 1477 | 148 | 1076 | 234 | 131 | 25 | 2080 | 618 |
| $I_6$ - 10 DAS | 1516 | 1399 | 1541 | 114 | 1142 | 338 | 231 | 31 | 1494 | 524 |
| $I_7$ - 20 DAS | 1414 | 1016 | 1555 | 138 | 1031 | 209 | 122 | 53 | 2070 | 613 |
| $I_8$ - 20 DAS | 813 | 753 | 1484 | 125 | 794 | 355 | 591 | 63 | 1806 | 754 |
| Mean | 1374 | 1195 | 1550 | 133 | 1062 | 373 | 255 | 47 | 1887 | 633 |

| | S. Em.± | C. D. at 0.05 | | S. Em.± | C. D. at 0.05 |
|---|---|---|---|---|---|
| I | 43.094 | 126.764 | I | 67.22 | N.S. |
| H | 39.240 | 110.434 | H | 159.61 | 449.18 |
| I × H | 110.989 | 312.353 | I × H | 451.45 | N. S. |

NS = Not Significant DBS = Days before sowing DAS = Days after sowing

ost of hand weeding, herbicide was conducive. The reatment irrigation at sowing and isoproturon at ne rate of 0.5 kg/ha combination ($I_3H_1$), irrigation t 10 DAS and Isoproturon at the rate of 5 kg/ha $_6H_1$) were found beneficial both on yield and anagement point of view. The interaction $I_1H_1$, $H_1$, $I_4H_1$ and $I_5H$ were at par but found difficult in anagement compared to previous two ombinations.

*(Received on 11th July, 1988)*

## REFERENCES

Blair, A. M. (1985). Influence of soil moisture on isoproturon activity against *Alopecurus myosuroides. Weed Res.*, **25** (2) : 141-149.

Mehta, H. M., Trivedi, G. C. and Patel, H. R. (1985). Study the efficacy of herbicides for weed control in *isabgul (Plantago ovata).* In Abstract of papers, ISWS, Weed Sci. Conf., G.A.U. Anand, P. 75.

# Effect of Age of Transplants on the Growth and Yield of Onion under Low Land Condition

**M. U. Vachhani and Z. G. Patel**

Department of Agronomy,
Gujarat Agricultural University,
Navsari 396 450

In India onion is grown in an area of about 2.7 lakh hectares with the total bulb production of about 29 million tonnes and in Gujarat onion occupied an area of about fifteen thousand hectare with total bulb production of about five lakh tonnes (Anon. 1986). It is used as vegetable at all stages of its growth as well as for seasoning different foods all the year round.

Onion crop in South Gujarat is cultivated by raising seedlings in nursery and then transplanted in the field after harvesting Kharif paddy. The bulb yield of onion is greatly affected by vario agronomic practices but age of seedlings transplanting extent profound influence vegetative growth of the crop.

The experiment was conducted in Randomis block design on black soils of Navsari. Treatmen consisted of seven different ages of seedlings transplanting (4 to 10 week old) were replicat thrice. The seeds of onion variety Pusa Red we sown on 19th October, 1987 and seedlings we transplanted at a distance of 15 cm × 10 cm as p treatments. The crop was fertilized at the rate 100-50-100 kg NPK/ha. The irrigation an handweeding were done as per the need. The cro was harvested on 7th March, 1988 when most the tops had dried up.

The results on plant height, no. of leaves pe plant, diameter and weight of individual bulb an bulb yield of onion recorded during th investigation are presented in Table-1. The data indicated that the effect of age of seedlings on bulb weight was found to be significant but it did no exert any significant effect on plant height, numbe

*TABLE 1*

**Different growth and yield characters of onion as affected by age of the seedlings.**

| *Treatment* | *Age of seedling at transplanting (week)* | *No.of leaves/ plant* | *Plant height (cm)* | *Bulb diameter (cm)* | *Bulb weight (g)* | *Bulb yield (q/ha)* |
|---|---|---|---|---|---|---|
| $T_1$ | 4 | 9.67 | 54.0 | 4.69 | 50.67 | 257.67 |
| $T_2$ | 5 | 9.80 | 57.3 | 5.19 | 52.00 | 289.00 |
| $T_3$ | 6 | 10.13 | 58.9 | 5.23 | 54.67 | 313.33 |
| $T_4$ | 7 | 10.67 | 64.8 | 5.53 | 81.33 | 462.33 |
| $T_5$ | 8 | 10.60 | 64.3 | 5.34 | 71.33 | 420.00 |
| $T_6$ | 9 | 10.27 | 61.5 | 5.13 | 65.33 | 405.67 |
| $T_7$ | 10 | 9.60 | 56.8 | 4.53 | 62.00 | 325.33 |
| S. Em± | | 0.56 | 3.11 | 0.23 | 4.46 | 14.97 |
| C.D. at 5% level | | N.S. | N.S. | N.S. | 13.74 | 46.10 |

N. S. = Not significant

leaves per plant and the bulb diameter. Maximum ılb weight (81.33 g) was recorded under treatment ₄, but remained statistically at par with $T_5$. The eight of onion bulb reduced with the reduction in ge upto 4 weeks old seedlings and increased upto 0 weeks, when compared with 8 weeks old eedlings. The results also revealed that the onion ulb yield was also significantly affected by age of eedlings at transplanting. The highest bulb yield of 62.33 q/ha was recorded when 7 weeks old eedlings were transplanted ($T_4$) but remained on a ar with $T_5$. The bulb yield increased with an ncrease in age of seedlings upto 7 weeks. The yield ncrease was probably due increase in bulb weight nd to some extent increase in bulb diameter. The owest bulb yield (257.67 q/ha) was obtained with ₁ but remained at par with $T_2$.

According to Thompson and Kelley (1957) bulb rmation in most of the onion varieties is favoured y relatively long photo-periods and therefore, later lantings give higher yields than the earlier plantings. Similar results were also reported by Verma *et al.* (1971 and Singh and Singh 1974).

*(Received on 26th Oct. 1988)*

## REFERENCES

Anonymous, (1986). Agril. situation in India XL (11), 1079.

Singh, D. P.and Singh, R. P. (1974). Studies on the effect of time of sowing and age of seedlings on growth and yield of onion (*Allium cepa* L.), *Indian J. Hort.* 31 (1) : 69-73.

Thompson, H. C. and Kelley, W. C. (1957). Vegetable crops. Mc Graw Hill Book Co., New York. pp. 355.

Verma, J. P., Rathore, S. V. S. and Yadav, B. S. (1971). Performance of bulb crop of onion as affected by sowing dates and age of transplants. *Prog. Hort.* 3(2) : 29-34.

# Life Cycle of *Meloidogyne arenaria* on Groundnut

**H. R. Patel, M. U. Vaishnav**

Department of Plant Pathology,
College of Agriculture,
Gujarat Agricultural University,
Junagadh - 362 001

Root knot disease of groundnut caused by *Meloidogyne arenaria*, was observed in many fields of Sanala village of Rajkot district, Gujarat by Vaishnav and Dhruj (1981). Occurence of *M. arenaria* on groundnut has been earlier reported from Punjab, India by Sharma *et al.* (1978) and Mahajan and Chhabra (1979). The disease is considered economically very important in Gujarat, therefore, investigations on the life cycle of the namatode were initiated.

Ninty glass tubes of 40 ml. size were filled in with sterilized washed sand and one seed of groundnut (GAUG 10) was sown in each of the tubes. Five days after germination, 2 ml of nematode suspension containing approximately 100 freshly hatched second stage larvae were introduced near the roots in all the tubes.

Seedling from three tubes were removed (first after 12 hours) after every 24 hours and washed roots of the seedlings were stained in boiling 0.05 per cent acid fuchsin in lactophenol (Franklin, 1949). The stained roots were examined under steroscopic binocular microscope for larval penetration and developmental stages of the nematode, Hogland nutrient solution was added in the tubes, twice a week, for proper plant growth.

Penetration of second stage larvae in root started within 24 hours of inoculation and about 2 per cent of the larvae penetrated in 24 hours Majority of the larvae entered through root tips an meristematic regions of the root. The larva oriented themselves parallel to the longitudinal axi of the roots near the stele region. These larva enlarged in size and majority of them were swolle after six days. Third and fourth stages and youn females were observed 9, 14 and 16 days afte inoculation respectively. Mature females wit gelationous matrix were observed after 20 days an first egg was observed on 24th day. The nex generation of second stage larvae emerging from th eggs were observed on 28th day after inoculations Males were observed after 18 days. The life cycle o *M. arenaria* on groundnut was completed in 28 day at a temperature ranging between 27° and 33°C.

*(Received on 10th Sept. 1987*

## REFERENCES

Franklin, M. T. (1949). A quick method of demonstrating nematode of the genus *Aphelenchoides* in leaves. *J. Helminth.*, **23** : 91-93.

Mahajan, R. and H. K. Chhabra, (1979). Occurance of plant parasitic nematodes in Punjab, India. *Pans.* **25** : 46-49.

Sharma, N. K., S. K. Sharma and S. K. Midha, (1978). Root-knot disease of groundnut in Punjab, *Indian Farming*, **28** : 19-21.

Vaishnav, M. U., and I. U. Dhruj, (1981). Occurance of root-knot nematode in groundnut in Gujarat. Paper presented at the Nematology Symposium, 13-15 Feb. 1981, Tamil Nadu Agriculture University, Coimbatore, India.

AU Res. J. 1990. 15 (2) : 54-55

# Laboratory Evaluation of Some Insecticides for the Control of Pigeonpea Mealy Bug, *Coccidohystrix insolita* (Green)

**P. A. Bhalani**

Pulse Research Station,
Gujarat Agricultural University, Junagadh

The pigeonpea (TUR) is an important legume rop in the Gujarat state with an area of 3.29 lakh ectares and producing 2.52 lakh tonnes of grain. In ecent years, it is attacked by the mealy bugs, *Coccidohystrix insolita* (Green) (Coccidae: Hemiptera). This mealy bug is also reported to ttact brinjal (Chaudhari, 1976 and Nair and Nair 977) and pigeonpea (Patel *et al.*, 1985) in Gujarat. Review of literature showed that the information on he efficacy of insecticides to control mealy bugs in pigeonpea is scanty. Therefore, the present study was undertaken to study the efficacy of some promising insecticides for the control of *C. insolita* pigeonpea under laboratory condition at Junagadh (Gujarat) during October, 1987.

The last instar crawlers of mealy bugs *C. insolita* were collected from unsprayed pigeonpea field and used for the present study. The required concentrations of each insecticide (Table 1) were prepared. A film on blotting paper was prepared with the help of fine automizer by taking 1 ml of insecticidal solution in each petridish (9.5 cm diameter). The treated blotting papers were allowed to dry under a fan for 5 minutes. Eighty crawlers of the mealy bug were released on treated blotting papers of each insecticides. The crawlers in each treatment were distributed into four batches, thus forming four replications. The crawlers were given a continuous exposure to the insecticide film for one hour, after they were transfered to a separate clean glass petridishes (9.5 cm did meter) containing fresh buds and leaves of pigeonpea. Observations on nortality of bugs were recorded 1, 3, 16 and 24hr after the treatment. The moribund bugs were considered as dead. Statistical analysis was done by using Randomise Block Design after converting the mortality per cent data into arcsin angles.

The per cent cummulative mortality of mealy bug crawlers recorded 1, 3, 16 and 24hr after spraying are given in Table 1. The highest mortality (94.8 per cent) of the bugs was given by fenvalerate 0.02 per cent within 1hr of treatment and it was on par with carbaryl 0.2 per cent which gave 60.6 per cent mortality. The mortality per cent was above 40 per cent in the case of quinalphos, cypermethrin and fluvalinate and between 13.0 to 31.45 per cent in the remaning insecticidal treatments. Both fenvalerate and quinalphos, gave above 80 per cent mortality 3hr after application and these were significantly more effective than all the remaining treatments. The cumulative mortality 16hr after treatment exceeded 95 per cent in the case of quinalphos, fenvalerate and carbaryl and was significantly better than that those obtained in the other treatments. Five treatments, namely, monocrotophos, cypermethrin, fluvalinate, acephate and decamethrin gave between 60.23 and 80.67 per cent mortality. Quinalphos, fenvalerate, carbaryl and cypermethrin registered over 90 per cent mortality 24 hr after treatments which was significantly higher than that obtained in other treatments. The percentage mortality in the remaining treatments,except endosulfan and methyl parathion exceeded 60 per cent. Patel *et al.* (1985 b) reported that, monocrotophos, quinalphos, malathion and methyl-parathion remained effective upto 4 or 5 days against *C. insolita* on pigeonpea.

Thus, looking to these results, quinalphos 0.05 per cent, fenvalerate 0.02 per cent, carbaryl 0.2 per cent and cypermethrin 0.004 per cent were highly effective, killing above 93.23 per cent bugs within 24 hr of treatment. Decamethrin 0.04 per cent, fluvalinate 0.01 per cent and monocrotophos 0.04 per cent were also effective causing 72.0 to 83.6 per cent mortality. Endosulfan 0.07 per cent and methyl-paration 0.05 per cent were found less effective as they gave below 55 per cent mortality against this pest.

*(Received on 19th April, 1988)*

*TABLE 1*

**Comparative effect of different insecticides against the mealy bug, *C. insolita*.**

| Sr.No. | *Insecticide* | *Concentration (%)* | *Mean cumulative mortality per cent* | | | |
|---|---|---|---|---|---|---|
| | | | *Hours after spray* | | | |
| | | | *1* | *3* | *16* | *24* |
| 1 | Endosulfan (Thiodan 35 EC) | 0.07 | 21.14 (13.0) | 37.21 (36.56) | 43.06 (46.0) | 46.90 (53.3) |
| 2 | Monocrotophos (Monocil 40 EC) | 0.04 | 32.99 (29.7) | 44.98 (49.9) | 53.05 (63.89) | 59.68 (74.5) |
| 3 | Quinalphos (Ekalux 20 EC) | 0.05 | 48.41 (56.0) | 70.75 (89.12) | 78.90 (96.5) | 83.82 (98.89) |
| 4. | Fenvalerate (Fenval 20 EC) | 0.02 | 76.89 (94.89) | 83.82 (98.89) | 89.96 (100.0) | 89.96 (100.0) |
| 5. | Carbaryl (Sevin 50 WP) | 0.2 | 51.12 (60.6) | 63.90 (80.67) | 77.68 (95.45) | 89.96 (100.0) |
| 6. | Cypermethrin (Basathrin 25 EC) | 0.004 | 44.20 (48.6) | 63.90 (80.67) | 63.90 (80.67) | 74.97 (93.23) |
| 7. | Fluvalinate (Mavrik 25 EC) | 0.01 | 40.35 (41.9) | 53.05 (63.89) | 63.90 (80.67) | 66.12 (83.6) |
| 8. | Acephate (Orthane 7 WP) | 0.01 | 34.12 (31.45) | 41.05 (43.12) | 55.34 (67.67) | 55.13 (64.0) |
| 9. | Decamethrin (Decis 2.8 EC) | 0.04 | 30.77 (26.12) | 48.91 (56.0) | 50.92 (60.23) | 58.05 (72.0) |
| 10. | Methylparathion | 0.05 | 21.14 (13.0) | 26.06 (19.3) | 36.83 (35.9) | 46.99 (53.45) |
| 11. | Control | | 0.0 | 0.0 | 0.0 | 0.0 |
| | S. Em.± | | 8.93 | 5.55 | 6.18 | 5.67 |
| | C. D. at 5% | | 26.35 | 16.36 | 18.22 | 16.73 |

Figures in parentheses are transformed values.

## REFERENCES


Chaudhari, S. (1976). *Metarrhigizum anisopciae* (Meteni) Suro in on brinjal mealy bugs and its use in the biological control of the pest. *Current Science* **45**(1) : 34.

Nair, K. M. ;M.R.G.K. Nair (1977). Use of some insecticides and their mixture for control of brinjal pest. *Agril. Res. J. Kerala*, **14**(2) : 101-104.

Patel, G. M. ;A. S. Shah; M. B. Patel and C. B. Pat (1985 a). First record of *Coccidohysti insolita* (Green) as a pest pigeonpea in Sou Gujarat. *GAU RES. J.* **11**(1) : 61.

Patel, G. M. ; M. B. Patel; M. S. Purohit and A. S. Shah (1985 b). Evaluation of some insecticides against Tur mealy b (*Coccidohystrix insolita* (Green) laboratory condition. *Pestology*,

# Comparative Heat Tolerance in ersey × Kankrej ($F_2$) and Holstein Friesian × Kankrej ($F_2$) Heifers

K. S. Patel and A. D. Dave

Gujarat Veterinary College,
Gujarat Agricultural University, Anand

The important exotic donor breeds, most suited varying agro-climatic conditions in India, are the rsey, the Holstein Friesian and the Brown Swiss r crossbreeding in cattle. Crossing of Kankrej th Jersey and Holstein Friesian has been done at vestock Research Station of Gujarat Agricultural niversity, Anand Campus, to evolve suitable breed oss strain for Gujarat. Comparative heat tolerance Jersey × Kankrej ($F_1$) and Holstein Friesian × ankrej ($F_1$) heifers was studied by Das (1982). Vith an interest to know comparative heat olerance of Jersey × Kankrej $F_2$ ($JKF_2$) and Holstein riesian × Kankrej $F_2$ ($HKF_2$) heifers, an experiment as carried out in summer of 1985.

Two groups each of 4 heifers of JK $F_2$ and two roups each of 4 heifers of HK $F_2$, were continuously kept exposed to sun during the summer. One group of 4 heifers from each breed group was splashed water on their body for one hour between 1:00 to 2:00 p.m. daily. Observations on respiration rate, rectal temperature and pulse rate were recorded at 7:30 a.m. and 2:30 p.m. on ten selected hottest days in the months of April and May. The ambient temperature was more than 40°C, during afternoon, on these selected days.

The heat tolerance indices of the crossbred heifers were worked out by using the methods described by Benezra (1954), Mullick (1961) and Thomas *et al.* (1973). In estimating the heat tolerance indices of the heifers, the average values of the physiological responses recorded during the morning were used as normal values, and those recorded during the afternoon were taken as deviated values, due to heat stress. The average values of heat tolerance indices calculated by different methods are presented in Table 1.

The analysis of variance and F test indicated that the (control) unsplashed JK $F_2$ had better ($P < 0.05$) heat tolerance than the unsplashed (control) $HKF_2$ heifers, under all the three methods of heat tolerance calculations.

*TABLE 1*

**Average values of heat tolerance indices for JK $F_2$ and HK $F_2$ heifers.**

| *reed roup* | *Treatment* | *Method* | | |
|---|---|---|---|---|
| | | *Mullick's* | *Benezra's* | *Thomas' (Dairy Search Index)* |
| K $F_2$ | Unsplashed | 74.75 a,b ±1.9738 | 3.9825 a ±0.1547 | 1.56 b ±0.0242 |
| K $F_2$ | Splashed | 80.75 a ±0.8539 | 3.1425 a ±0.1347 | 1.36 a ±0.0382 |
| ba K $F_2$ re | Unsplashed | 59.50 c ±1.7078 | 5.0975 b ±0.6069 | 1.78 c ±0.1106 |
| HK $F_2$ | Splashed | 71.25 b ±3.3510 | 3.1125 a ±0.2871 | 1.3 a ±0.054 |
| | C. V. % | 6.05 | 18.31 | 8.72 |

ortal: ies within a column with different supercript differ significantly ($P < 0.05$).

The splashing treatment seems to improve the eat tolerance of both the crosses. It, however, lead o significant ($P < 0.05$) improvement in the heat olerance of only the HK $F_2$ heifers as indicated by ll the three methods. Only with the Thomas' ethod, the JK $F_2$ heifers showed a significant ($P <$ .05) improvement in the heat tolerance. Thus, for educing the summer heat stress, the splashing reatment was found to be more advantageous in he Holstein crosses than in the Jersey crosses.

The results are in agreement with Srivastava d Sindhu (1979), Das (1982) and Patel (1984), ho reported better heat tolerance in the Jersey osses than in the Holstein crosses.

*(Received on 22nd Feb. 1989)*

## REFERENCES

Benezra, R. (1954). A new index for measuring the adaptability of cattle to tropical conditions. *J. Anim. Sci.* 13 : 1015 (Abstract).

Das, M. K. (1982). Effect of sprinkling and splashing water on physiological responses o Kankrej × Jersey ($F_1$) and Kankrej × Holstein ($F_1$) heifers, during intense summer. M.V.Sc Thesis, Gujarat Agricultural University, Anand.

Mullick, D. N. (1961). The physiological efficiency of animals in tropics. Proc. 48th, Indian Sci. Cong. Part-II. Roorkee, pp. 210-223.

Patel, J. M. (1984). Studies on body surface area and skin characteristics in relation to heat tolerance and some production traits in Kankrej × Jersey and Kankrej × Holstein ($F_1$) crossbreds. Ph.D. Thesis, Gujarat Agricultural University, Anand.

Srivastava, S. M. and Sindhu, N. S. (1979). Heat tolerance studies on various crossbred genetic groups of cattle in U.P. (Izatnagar). *Indian J. Heredity.* 11 : 77-83.

Thomas, C. K., Sharma, K. N. S., George, G. C. and Razdan, M. N. (1973). A new heat tolerance index for cattle. *Indian J. Anim. Sci.* 43 : 505-10.

# Abstracts of Ph.D. Thesis

## Effect of Weed Control Methods and Nitrogen Levels on Wheat (*Triticum aestivum* L.) and their Residual Effect on Succeeding Summer Green Gram Crop

Submitted to Gujarat Agricultural University
1988 by

**S. S. Bainade**

Department of Agronomy,
N. M. College of Agriculture,
Gujarat Agricultural University,
Navsari Campus, Navsari

Field experiments were conducted on a vertisol oil of Agricultural College Farm, Navsari (Gujarat) uring *rabi* and summer seasons of the years 986-87 and 1987-88, for studying the effect of ifferent weed control methods and levels of itrogen on wheat var. GW-120 (*Triticum stivum* L.) and their residual effect on succeeding rop of green garm.

The study involved six weed control treatments iz., unweeded control, two hand weedings, pplication of isoproturon at 1.0 kg/ha, endimethalin at 1.0 kg/ha, anilofos at 0.4 kg/ha ll pre-emergence) and fluchloralin at 1.0 kg/ha 10 DAS) in main plot and four levels of nitrogen .e., 60, 90, 120 and 150 kg N/ha in sub plot reatments replicated four times in a split plot lesign. The experimental soil was clayey in texture, ow in total nitrogen, medium in available hosphorus and fairly rich in available potash.

Yields of grain and as well as all the growth and eld attributing characters were significantly ffected due to different weed control methods and itrogen levels. Application of fluchloralin tended to ive highest yields of grain (3716 kg/ha) and straw 5654 kg/ha), although comparable yields were tained with pendimethalin and two hand weeding atments due to effective control of weed pulation and weed biomass. The herbicide uron exhibited phytotxicity on wheat plants during 14-24 DAS only. Similarly, all the growth and yield attributes as well as grain and straw yields of wheat were increased with increase in nitrogen application rate upto 150 kg/ha, eventhough 120 kg N/ha recorded statistically similar values for several characters. Dry weight of weeds was also markedly increased upto highest level of nitrogen.

The chemical analysis of grain and straw of wheat samples showed the highest uptake of nutrients (N, $P_2O_5$ and $K_2O$) in fluchloralin treated plots, while unweeded crop plants showed the lowest uptake. The removal of nutrients through weeds were lowest in two hand weeding treatment. The removal of nutrients by crop and weeds were also significantly increased with increase in level of nitrogen upto 150 kg/ha.

All the weed control methods and increased rate of nitrogen improved the grain quality of wheat in terms of protein content and protein yield. The higher protein content and protein yield was obtained with two hand weedings and application of 120 and 150 kg N ha$^{-1}$. Herbicides pendimethalin and fluchloralin also improved the protein content of wheat.

The highest net economic returns of Rs. 5377/ha was obtained with fluchloralin, followed by pendimethalin (Rs. 4775) and two hand weeding (Rs. 4624) treatments. The respective net returns per rupee invested were 1.13, 0.99 and 0.95 rupee. The economic net returns with 150 and 120 kg N ha$^{-1}$ were Rs. 5314 and Rs. 5157 ha$^{-1}$, respectively with equal (Rs. 1.08) net returns per rupee invested.

The weed control treatments as well as nitrogen applied to preceding wheat crop did not leave any residue in the soil to effect the succeeding green gram crop adversely or favourably.

Based on the experimental results from data of two years, it can be concluded that application of 120 kg N/ha and fluchloralin at 1.0 kg/ha at 10 DAS is worth adopting as it gave better yields and highest economic returns with efficient control of weeds.

(Received on 25