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Management of termite by broadcasting of novel insecticides in standing crop of wheat

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ABSTRACT

Field experiment was carried out for the management of termite by broadcasting of novel insecticides in standing crop of wheat on cv. GW 496 during 2016-17 crop seasons at Wheat Research Station, SDAU, Vijapur, Gujarat. Seven insecticidal treatments viz., imidacloprid 17.8 SL, fipronil 5 SC, thiamethoxam 30 FS, imidacloprid 600 FS, clothianidin 50 WDG, fipronil + imidacloprid 40% WG, chlorpyriphos 20% EC and untreated control check were evaluated against termite by broadcasting method with the help of sand. The minimum per cent damaged effective tiller/m row and number of damaged effective tillers/ha were found in plots treated with fipronil + imidacloprid 40% WG @ 400 g a.i./ha. The maximum grain yield in g/m row from the same treatment followed by treatment of fipronil 5 SC @ 125 g a.i./ha against termite infesting wheat.

Key words: Broadcasting, damaged effective tiller, insecticidal treatment, termite, fipronil + imidacloprid 40 WG

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Termite *(Odontotermes abesus Rambur)* is predominant insect pest causing 20-40 per cent damage to the wheat crop in the field condition mainly in rainfed areas (Misra *et al.*, 2003). Termites damage were a major problem in Rajasthan and some parts of Madhya Pradesh whereas their damage was low in clay and black soils, high in sandy loam soils and severe in red soils (Sharma *et al.*, 2004). High incidence of termites was also observed in fields of fallow-wheat, sorghum-wheat, maize-wheat and bajra-wheat cropping systems. Similarly, the infestation of termite was higher in rainfed fields as compared to irrigated fields (Sharma *et al.*, 2004). Termite damage may lead to poor germination in crops like sugarcane, wheat, gram, maize, cotton, groundnut, chillies etc. however, their incidence at maturity stage lead to drastic reduction of yield (Verma and Kashyap, 1980). Sharma (1967) estimated the termite losses to wheat crop varying from 0 to 15 per cent in western Rajasthan. At present, insecticides are the mainstay for termite management strategies in crops and urban areas in India and the world (Peterson *et al.*, 2006; Potter, 2011). Termites are extremely difficult to manage since they live in underground nest with ramification of galleries thus chemical pesticides are the only means for the management of termite at present (Rathour *et al.*, 2014). Chemicals insecticides like fipronil, bifenthrin, chlorpyriphos, endosulfan, cypermethrin, imidacloprid, carbosulfan and triazophos were being recommended for control of termite (Kumawat, 2001; Rana *et al.*, 2001; Kishor *et al.*, 2017). Thus, the present investigation was carried out for the evaluation of effect of broadcasting method of novel insecticides against termite in standing crop of wheat in field condition.

MATERIALS AND METHODS

Field experiment was carried out for the management of termite by broadcasting of novel insecticides in standing crop of wheat on cv. GW 496 during 2016-17 crop seasons at Wheat Research Station, SDAU, Vijapur, Gujarat. Experiment was laid out in Randomized Block Design (RBD) in three replications. The net plot size was 13 x 1.6 m with row to row spacing of 20 cm. Seven insecticidal treatments viz., imidacloprid 17.8 SL @ 80 g a.i./ha, fipronil 5 SC @ 125 g a.i./ha, thiamethoxam 30 FS

@ 75 g a.i./ha, imidacloprid 600 FS @ 144 g a.i./ha, clothianidin 50 WDG @ 100 g a.i./ha, fipronil + imidacloprid 40% WG @ 400 g a.i./ha, chlorpyriphos 20% EC @ 600 g a.i./ha and untreated control check were evaluated against termite by broadcasting method. The required amount of insecticides were diluted first in 5 liter of water and then mixed with 100 kg of sand or loose soil per hacter and broadcasted on crop area just after the initiation of termite damage followed by light irrigation. In each plot five spots each of 2 m row length were randomly selected and ear marked permanently for recording observations. Observations on total number of healthy and termite damaged effective tillers from the spots as well as from net plot were recorded just before maturity of the crop and presented as per cent damaged effective tillers and number of damaged effective tillers per m row length and hacter respectively. Grain yield from net plots were recorded ad expressed in q/ha.

RESULTS AND DISCUSSION

There was no termite damage noticed in all the insecticidal treatments after 3rd, 4th and 5th weeks of sowing including the untreated check. At ear head stage, per cent damaged effective tillers/m row was minimum in fipronil + imidacloprid 40% WG @ 400 g a.i./ha and it was at par with all the insecticidal treatments except clothianidin 50 WDG @ 100 g a.i./ha, chlorpyriphos 20% EC @ 600 g a.i./ha and untreated check (Table 1). The number of damaged effective tillers/ha was significantly higher in untreated check as compared to insecticidal treatments. Among all the insecticidal treatments, it was significantly less in fipronil + imidacloprid 40% WG @ 400 g a.i./ha and it was at par with fipronil 5SC @ 125 g a.i./ha, imidacloprid 17.8SL @ 80 g a.i./ha and imidacloprid 600 FS @ 144 g a.i/ha. The grain yield in g/m row revealed non-significant difference among the insecticidal treatments. The maximum grain yield was recorded in plot treated with higher dose of fipronil + imidacloprid 40% WG @ 400 g a.i./ha and fipronil 5SC @ 125 g a.i./ha. The grain yield (q/ha) was also found non-significant however, the highest grain yield was recorded higher dose of fipronil + imidacloprid 40% WG @ 400 g a.i./ha followed by fipronil 5 SC @ 125 g a.i./ha (Table 1).

Similar finding was reported by Kishor et al., 2017 where the minimum damage of affected tillers/m row was 0.40 and 0.41per cent in the treatments of fipronil 5 SC @ 3.0 lit/ha and imidacloprid 600 FS @ 1.5 lit/ha likewise, the recorded grain yield in both g/m row and q/ha were significantly higher in treated plot with fipronil 5 SC @ 3.0 lit/ha and imidacloprid 600 FS @ 1.5 lit/ha with 39.75q/ha and 39.25 q/ha respectively. Moreover, the minimum damaged number of effective tillers/ha were recorded in treated plots with fipronil followed by treated plots with imidacloprid and thiamethoxam as well as the grain yield in both g/m row and q/ha were also significantly higher in treated plot with fipronil (38.61g/m row and 18.17q/ha) followed by treated plots with imidacloprid (37.38g/m row and 17.75q/ha) and thiamethoxam (36.25g/m row and 17.50q/ha) against termite of wheat as reported by Singh et al. (2015).

CONCLUSION

Broadcasting of fipronil + imidacloprid 40% WG @ 400 g a.i./ha was found effective followed by fipronil 5 SC @ 125 g a.i./ha for the management of termite in the standing crop of wheat and also provided the maximum grain yield amongst all the insecticidal treatments.

REFERENCES

Kishor, K., Kumar, J., Vikrant, S. K., Dotasara and Sharma, S. 2017. Wheat crop damaged by termite and co-related of different doses of insecticidal treatment compared with yield in standing crop. International Journal of Current Microbiology and Applied Sciences, 6 (12):449-454.

Kumawat, K. C., 2001. Evaluation of some insecticides against field termites, Odontotermes obesus and Microtermes obesi in wheat, Triticum aestivum. Annals of Plant Protection and Sciences, 9:51-53.

Mishra, R. D., Sharma, R. K., Singh, K.P., Parsohan, P. A., Tiwari, A. N., Verna, R. S. and Jaiswal.

2003. Wheat Research Pantnagar, Research Bulletin No. 132, Directorate of Experiment Station, GBPUA&T, Pantnagar, Uttarakhand. 47-49.

Peterson, C., Wagner, T. L., Mulrooney, J. E. and Shelton, T. G. 2006. Subterranean termites-their prevention and control in buildings. USDA Home and Garden Bulletin. 64.

Potter, M. F. 2011. Termites: In handbook of pest control: the behaviour, life history, and control of household pests, 10th ed. A. Mallis, S.A. Hedges & D. Moreland (Eds). Cleveland: GIE Media Inc.

Rathour, K. S., Ganguly, A. S., Das, T. K., Singh, P., Kumar, A. and Somvanshi, V. S. 2014. Biological management of subterranean termites (Odontotermes obesus) infesting wheat and pearl millet crops by entomopathogenic nematodes. Indian Journal of Nematology, 44 (1): 97-100.

Rana, J. S., Ombir and Dahiya, K. K. 2001. Management of termite, Microtermes obesi (Holmgren) in wheat, Triticum aestivum through seed treatment. Annals of Biology, 17: 207-209.

Sharma, S. K. 1967. Annual Progress Report for 1966-67 on termite infesting field crops and fruit trees in Rajasthan. Jodhpur (Rajasthan Dept. of Agric.). pp5.

Sharma, A. K., Babu, K. S., Nagarajan, S., Singh, S. P. and Kumar, M. 2004. Distribution and status of termite damage to wheat crop in India. Indian Journal of Entomology. 1: 235-237.

Singh, N. V., Kumar, J. and Singh. D. K. 2015. Efficacy of different insecticidal seed treatment against termite in wheat (Triticum aestivum L.) Crop Research in Environment and Life Sciences, 8 (2): 243-244.

Verma, A. N. and Kashyap, R. K. 1980. Termites their damage and control in field crops. Memoir No.8, New Delhi, Entomological Society of India.53.

Table 1. Effect of broadcasting of novel insecticidal in standing crop of wheat against termite

S. N.	Treatment	Dose (g a.i./ha)	% damaged effective tillers/m row	No. of damaged effective tillers/ha	Grain yield	
					g/m	q/ha
1.	Imidacloprid 17.8 SL	80	4.40*abc (0.59)**	649+ab (10763)++	63.00	34.86
2.	Fipronil 5 SC	125	4.23ab (0.54)	632ab (9902)	66.00	36.24
3.	Thiamethoxam 30 FS	75	5.90abcd (1.08)	849b (20889)	60.00	32.68
4.	Imidacloprid 600 FS	144	5.58abcd (0.94)	802b (22353)	61.00	34.27
5.	Clothianidin 50 WDG	100	11.57de (4.03)	850b (28199)	54.00	31.84
6.	Fipronil+ imidacloprid 40% WG	400	3.76a (0.43)	484a (4887)	66.00	36.33
7.	Chlorpyriphos 20% EC	600	17.91de (9.45)	858bc (29298)	52.00	31.26
8.	Untreated check	-	26.88f (20.42)	1062c (77613)	51.00	31.09
S.Em±			2.14	102	5	2.21
C.D. at 5%			6.50	311	NS	NS
C.V. %			37.02	22.95	13.43	11.41

*Figures followed within same column are Arcsin percentage transformation

**Figures given in parenthesis are Reangular value

+Figures followed within same column are Logarithmic transformation

++ Anti-logarithmic transformed values in parenthesis

Figure followed with same letters are not differed statistically

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Status of pomegranate fruit diseases in Kutch district

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ABSTRACT

Survey was conducted in the eight locations of Bhacahu taluka and six locations of Anjar taluka during 2017-18, observed the Alternaria leaf / fruit spot and anthracnose fruit diseases of pomegranate. Maximum disease severity (36.5%) of alternaria fruit spot was observed in the Chobari village of Bhachau taluka. Infection of anthracnose was found maximum (35.20%) at Bhachau. Diseased samples were collected during the survey and pathogens were isolated. Based on the morphological characters pathogens were identified and pathogenicity was proved.

Key words: Survey, Pomegranate, Alternaria leaf spot, Anthracnose

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Pomegranate (Punica granatum L.) is an ancient and commercially important fruit belongs to the family punicaceae. Pomegranate is a native of Iran. India contributes around 50 per cent to the total global pomegranate production. Maharashtra, Karnataka and Gujarat are the leading states, cultivating pomegranate on large scale. In Gujarat Kutch district is the second largest producer of the pomegranate after the Banaskantha (Anon., 2017). Successful cultivation of pomegranate in recent years suffers from various diseases such as, fruit rot, bacterial spot/canker and anthracnose etc. causing significant loss in the recent years (Anon., 2013). Among these fruit spots caused by Colletotrichum gloeosporioides and Alternaria alternata, take a heavy toll on the crop. This results in drastic reduction in the yield as well as marketability. Alternaria alternata causes both fruit spot/rot and leaf spot on pomegranate.

Madhukar and Reddy (1976) in India reported for the first time a leaf spot due to A. alternata on pomegranate, Farr et al. (2007) reported the fruit rot caused by Alternaria sp. in USA, Mexico. In India, anthracnose disease was first reported by McRae (1924). Leaf spot and fruit rot (A. alternata) has been noticed in northern Karnataka including Bijapur, Bagalkot and Koppal districts with disease severity ranging from 15-80 per cent in almost all the pomegranate growing areas (Archana, 2012). Anthracnose was recorded the severity from 19.99 to 28.76 per cent in major pomegranate growing areas of Karnataka (Nargund et al., 2012). In Gujarat Kutch district is the second largest producer of the pomegranate after the Banaskantha (Anon., 2017). Successful cultivation of pomegranate suffers from many diseases, it is ultimately reduces the market value. In order to know the severity of the different fruit spot of the pomegranate the present study was undertaken.

MATERIALS AND METHODS

Survey

Roving survey was conducted during 2017-18 in Kutch district. In Kutch district, major pomegranate growing Bhachau and Anjar talukas were selected and in each taluka six to seven villages were selected, five orchards were randomly selected in each village for survey study. Observations on disease severity, stage of the crop, cultivar and Bahar details were recorded. Severity was recorded by following 0 to 5 scale during fruit development stage to maturity stage. Leaf infection was also recorded by following 0 to 5 scale (Nargund et al., 2012)

STATUS OF POMEGRANATE FRUIT DISEASES

Grade	Per cent area of infection on fruit		Reaction
	On fruit	On leaf	
0	No infection	No infection	Immune
1	1-10	Upto 5	Resistant
2	11-25	6-10	Moderately resistant
3	26-50	11-20	Moderately susceptible
4	51-75	21-50	Susceptible
5	>75	50	Highly susceptible

Per cent disease index (PDI) was calculated by using following formula proposed by Wheeler (1969).

$$PDI = \frac{\text{Sum of the individual disease ratings}}{\text{Number of fruits observed} \times \text{Maximum disease grade}} \times 100$$

Isolation, identification, proving pathogenicity and studies on symptoms: The isolation of the fungus was made by standard tissue isolation technique. Pathogens were identified with microscopic observation by taking mycelial and spore characters. Pathogenicity of the isolated fungus was tested by following Koch's postulates on cultivar Bhagwa Sinduri raised in pots. Plants were inoculated with the pure culture and incubated for symptom expression. Symptoms appeared within ten days after inoculation of the plants. Symptoms were compared with the original symptoms of the disease. The fungus was reisolated and observed for the morphological characters.

RESULTS AND DISCUSSION

Alternaria leaf/ fruit spot

Survey: Roving survey was carried out in the Bhachau and Anjar taluka of Kutch district during 2017-18, the diseases observed and their severity was recorded both on the leaf and fruit, the results obtained were presented in the Table 1.

Alternaria leaf spot was observed in all the locations surveyed with severity ranged from 4.5 to 16.6 per cent with mean severity of 8.71 per cent. Maximum PDI (16.6%) was observed in the Chobari village of Bhachau taluka, followed by Navagam (PDI 11.7%) and least was observed in May village and Regional Research Station, Bhachau that is 4.5 per cent. Alternaria fruit spot was severity was ranged from 5.8 to 36.5 per cent with mean severity of 17.08 per cent. Maximum disease severity of 36.5 per cent was observed in Chobari village of Bhachau taluka, followed by Sangamner (24.5 %) village of Bhachau taluka and least PDI (5.8 %) was observed in the Regional Research Station, Bhachau. In all the surveyed locations, Bhagwa Sindhuri was major cultivar of pomegranate and most of the farmers followed either Mrig Bahar or Hasta Bahar treatment, it indicated that the cultivar Bhagwa Sindhuri was found moderately resistant (MR) to moderately susceptible (MS) category as per the disease rating scale. Presence of favorable environmental conditions, growing susceptible cultivars, build up of inoculum level year after year due to improper pruning practices are the main reasons for maximum disease severity. Same observations have been recorded by Archana (2012), who conducted the survey in northern Karnataka and reported 15-80 per cent severity of Alternaria fruit spot/rot. Adesh et al., (2017), conducted the farm survey at Punjab Agricultural University, Punjab and reported that among five cultivars Bhagwa cultivar recorded the maximum disease severity.

Isolation, identification, proving pathogenicity and studies on symptoms: Spots are small dark brown in color and round or irregular concentric rings were observed in the centre. Later these spots increased in the size, coalesced and affected leaves become yellow and dropped down. On the fruits they may cover larger fruit area. Symptoms observed during the survey have been presented in the photographs (Fig. 1). Diseased leaf samples

were collected from the pomegranate fields during the survey. Pure culture was established by single spore isolation method. The fungus was identified as *Alternaria alternata* (Fr.) Keissler by comparing its morphological characters with the published reports (Ellis, 1971) and proved the pathogenicity by following Koch's postulates.

Anthracnose

The disease severity of anthracnose on leaf was varied from 0 to 12.8 per cent. Maximum disease severity of 12.8 per cent was observed at Bhachau local area, followed by Satapar village of Anjar taluka with 11.8 per cent severity. Orchards were found disease free in Ambapar and Nagalpar villages of Anjar taluka. On the fruit the disease severity was ranged from 0 to 35.2 per cent. The maximum PDI (35.2 %) was recorded in Bhachau local area. Fruit infection of anthracnose was absent in the Ambapar and Nagalpar villages of Anjar taluka. Bhagwa Sindhuri cultivar was showed the resistant (R) to moderately susceptible (MR) reactions in all the surveyed locations. Higher temperature during the Mrig Bahar with intermittent rainfall have contributed for maximum disease severity. Same observations were recorded by the Chavan and Dhutraj (2017), who conducted the survey Parbhaani district of Marathwada region of Maharashtra state. Cultivation of the same cultivar in the large area results in buildup of the inoculum.

Isolation, identification, proving pathogenicity and studies on symptoms: Pinhead size of black to brown water soaked spots appeared on the leaves with circular margin. In advanced stage, these spots enlarged, coalesced and resulted in bigger patches. In severe case leaves dried up. On fruits, brown spherical depressed spots occurred in scattered form on the pericarp. In advanced stage, these spots coalesced to form necrotic patches over the surface of the fruit (Fig. 2). Diseased leaf samples were collected from the pomegranate fields during the survey. Pure culture was established by single spore isolation method. The fungus was identified as Colletotrichum gloeosporioides (Penz.)Penz. & Sacc. by comparing its morphological characters with the published reports (Ellis, 1971). Healthy seedlings developed from the air layers of 4-5 years old pomegranate cv. Bhagwa Sindhuri were raised in earthen pots, size 6"×5" filled with sterilized soil. Pathogenicity of the isolated fungus was tested following Koch's postulates.

REFERENCES

Adesh. K., Tanjeet S. C., Mandeep S. H., Harminder Kaur and Roomi R. 2017. Studies of alternaria black spot disease of pomegranate caused by *Alternaria alternata* in Punjab. *J. Appl. Natural Sci.*, **9** (1): 156 -161.

Anonymous, 2013. Improved Cultivation Practices for Horticulture Crops. University of Agricultural Sciences, Dharwad, India, p. 470.

Anonymous, 2017. Horticultural statistics at a glance. 2017. Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, p. 281.

Archana, B. C. and Jamadar, M. M. 2014. Management of leaf spot and fruit spot/rot of pomegranate (*Punica granatum* L.) caused by *Alternaria alternata* (Fr.) Keissler*. *Karnataka J. Agric. Sci.*, **27** (2): 247-249.

Chavan, A. A. and Dhutraj, D. N. 2017. Survey on pomegranate anthracnose caused by *Colletotrichum gloeosporioides* (Penz.) In Marathwada region. *Indian J. Agric. Res.*, **51** (2): 155-160.

Ellis, M. B. 1971. Dematiceous hypomycetes. Commonwealth Mycological Institute Kew Surrey, London, p. 452-459.

Farr, D. F., Rossman, A. Y., Palm, M. E., McCray, E. B. 2007. Fungal diseases, Systematic Botany & Mycology Laboratory, ARS, USDA. from http : //nt. ars-grin. gov/fungaldatabases.

Madhukar, J. and Reddy, S. M. 1976. Some new leaf spot diseases of pomegranate. *Indian J. Mycol. Pl. Pathol.*, **18**: 171-172.

McRae, W. 1924. Economic Botany part-III. Mycology. Annu. Rep. (1922-23). Board of Scien. Advice. India, p. 31-35.

Nargund, V. B., Jayalakshmi, K., Benagi, V. I., Byadgi, A. S. and Patil, R. V. 2012. Status and management of anthracnose of pomegranate in Karnataka State of India. Options Mediterraneennes- International Symposium on the Pomegranate, p. 117-119.

Wheeler, B. E. J. 1969. An introduction to plant disease. John Wiley Sons Limited, London, p.301.

Table 1 Status of pomegranate fruit diseases in Kutch district

District	Taluka	Village	Genotype	Bahar	Stage of the crop	Per cent Disease Index/Severity			
						On Leaf		On Fruit	
						Alternaria Leaf Spot	Anthra cnose	Alternaria Fruit Spot	Anthra cnose
Kutch	Bhachau	Bhachau local	Bhagwa sinduri	Mrig	Flowering & Fruiting	10.6	12.8	18.6	35.2
		Chobari	Bhagwa sinduri	Mrig	Flowering & Fruiting	16.6	8.6	36.5	12.1
		Gunatitpura	Bhagwa sinduri	Hasta	Flowering & Fruiting	6.5	8.0	11.8	9.2
		Kharoi	Bhagwa sinduri	Mrig	Flowering & Fruiting	9.8	5.8	21.5	10.6
		Manfara	Bhagwa sinduri	Mrig	Flowering & Fruiting	5.8	4.6	10.6	11.6
		May	Bhagwa sinduri	Mrig	Flowering & Fruiting	4.5	5.7	11.5	9.6
		RRS, Bhachau	Bhagwa sinduri	Hasta	Flowering & Fruiting	4.5	4.0	5.8	6.6
		Sangamner	Bhagwa sinduri	Mrig	Flowering & Fruiting	11.5	11.6	24.5	28.8
	Taluka Mean					8.72	7.63	17.60	15.46
	Anjar	Ambapar	Bhagwa sinduri	Mrig	Flowering & Fruiting	9.6	-	13.9	-
		Nagalpar	Bhagwa sinduri	Mrig	Flowering & Fruiting	8.9	-	14.5	-
		Navagam	Bhagwa sinduri	Mrig	Flowering & Fruiting	11.7	10.8	21.8	20.8
		Pashwadi	Bhagwa sinduri	Mrig	Flowering & Fruiting	5.6	6.8	12.9	19.9
		Satapar	Bhagwa sinduri	Mrig	Flowering & Fruiting	10.5	11.8	22.9	33.5
		Rampar	Bhagwa sinduri	Mrig	Flowering & Fruiting	5.9	10.8	13.4	16.6
	Taluka Mean					8.70	6.70	16.56	15.13
District Mean						8.71	7.16	17.08	15.29

Appearance of small concentric ring spots on the leaves and flower

Figure 1 Symptoms of Alternaria leaf/ fruit spot

Pin head sized spots on leaves

Small depressed spots on the fruit

Severely infected fruits showing necrotic patches
Figure 2 Symptoms of anthracnose of pomegranate

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Mahisagar (IET-22100): A superior early maturing fine grained rice variety with better quality

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ABSTRACT

Rice (*Oryza sativa* L.) is an important staple food of more than half of the world population and ¾th of the Indian population. In India rice is grown in 43 million hectare with 102.80 million tonnes production accounting productivity of 2390 kg./ha. In Gujarat rice is grown on an average about of 0.79 million hectares with a total production of 1.85 million tonnes with productivity of 2349 kg ha-1.

So far in Gujarat, there is an urgent need to enhance the productivity and income of farmers, self sufficiency in rice production. Hence, systematic efforts were made to evaluate superior, early, medium slender kernel typerice variety with better cooking and milling qualities and inbuilt resistance to pests and disease at Main Rice Research Station, Anand Agricultural University, Nawagam. Mahisagar (IET-22100) a rice variety derived from the cross CN-540 x IR-50 and evaluated through pedigree selection method was tested in 20 trials conducted over 5 years at 5 locations of Middle and South Gujarat. On an average, the yield of Mahisagar (4593 kg ha-1) was exhibited 29.8 per cent and 6.6 per cent higher over the checks GR-4 (3515 kg ha-1) and GR-12 (4309 kg ha-1), respectively. The plant type is erect with none-lodging, foliage is green with strong culm, spikelet is awnless and non shattering habit and easy to thresh. The cooking and milling qualities are better than the checks. The milling quality and head rice recovery was found 71.08 per cent and 62.4 per cent, respectively, hence fetches more price in market. The variety is early mature (121 to 125 days) with medium slender kernel type. It is less prone to pests and disease. Considering salient features, Mahisagar is well suited for commercial cultivation under irrigated, transplanted condition ecosystem in Middle and South Gujarat. The performance of Mahisagar variety was praised by farmers and traders and year by year becoming more popular in Gujarat.

Key words: Grain yield, cooking and milling qualities, mahisagar, pests and disease

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Rice (*Oryza sativa* L.) is the most important food crop and energy source for about half of the world's population and ranks second in production after wheat (Manjappa *et al.*, 2014). Rice occupies a unique position in many nations because of its importance in traditional diets and the main source of income of many peoples. It is considered the most popular and important field crop in India for several reasons: as a staple food after wheat, as an exporting crop, as a land reclamation crop for improving the productivity of the saline soils widely spread in southern part and coastal area of India and finally it is a social crop in which every person of the farmers family could find work in rice fields and earn money during the growing season. Rice crop plays a significant role in India, as strategic crop for sustaining the food self-sufficiency. In India rice is grown in 43 million hectare with 102.80 million tonnes production accounting productivity of 2390 kg ha^{-1}. (Anon., 2015). In Gujarat rice is grown on an average about in an area of 0.79 million hectares with a total production of 1.85 million tonnes with productivity of 2349 kg ha^{-1} (Anon., 2018).

So far in Gujarat, there is an urgent need to enhance the productivity, self-sufficiency in rice and enhance the income of farmers. Hence, systematic efforts were made to evaluate a superior early, medium slender kernel type rice variety with better cooking and milling qualities and inbuilt resistance to pests and disease. Keeping in view the above points, twenty rice genotypes were evaluated using pedigree selection method.

MATERIALS AND METHODS

The present investigation was carried out at the farm of Main Rice Research Station, Anand Agricultural University, Nawagam for five successive years during 2010 to 2014. The genotype Mahisagar (IET-22100) was developed through cross (CN-540 x IR-50) by using pedigree selection method. The genotype, Mahisagar (IET-22100) was evaluated for yield and yield attributing traits along with other promising entries including check varieties, Gujarat Rice 12 and Gujarat Rice 4. Initially, the yield performance was evaluated in small scale varietal trials (SSVT-E) at different four locations viz; Nawagam, Dabhoi, Dahod and Vyara in Gujarat. Further it was evaluated in large scale varietal trial (LSVT-E-F) in 13 trials at five different locations during Kharif 2012 to Kharif 2014. The Mahisagar (IET 22100) was also tested at Nawagam in IVT-IME, AVT-I-IME and AVT-II IME (AICRIP) trial during Kharif 2010, Kharif 2011 and Kharif 2012, respectively.

The experiment was laid out in a randomized block design (RBD) with three replications. Every genotype was grown with ten lines in net plot having 4.95 meter length and two meter width by keeping 20 cm × 15 cm plant spacing and all the recommended cultural practices for rice cultivation were applied. Fifteen quantitative and qualitative characteristics i.e. maturity days (seed to seed), plant height (cm), panicle length (cm), number of productive tillers/ plant, 1000-grain wt (g), number of filled grains/ panicle, grain length & breadth (mm), kernel length/ breadth (mm), LB ratio, grain yield (kg/plot), reaction to diseases, reaction to major pests, hulling per cent and milling per cent were studied. The data pertaining to various characters were analyzed as per the statistical procedure of randomized block design given by Panse and Sukhatme (1969) for individual environments.

RESULTS AND DISCUSSION

Based on yield performance of genotypes, the promising line Mahisagar (IET-22100) was out yielded highest grain yield. Experimental results revealed that the variety Mahisagar (4593 kg ha^{-1}) had exhibited 29.8 per cent and 6.6 per cent higher yield over the checks GR-4 (3515 kg ha^{-1}) and GR-12 (4309 kg ha^{-1}), respectively. It was out yielded over` GR-12 and GR-4 check varieties in 14/20 tests and 13/17 tests, respectively (Table 1). Whereas, in South Gujarat variety, Gujarat Navsari Rice-4 (GNR-4) performed 4409 kg ha^{-1} grain yield reported by Mistry and Patel (2014). The crop growing period of Mahisagar was found (121-125 days) which is most desirable water saving traits mentioned in Table 2; whereas, the variety Gujarat Navsari Rice-4 (GNR-4) recorded 135-140 maturity days as mid late variety recorded by Mistry and Patel (2014).

Mahisagar showed early maturity (121 to 125 days) with medium slender kernel type. The yield potential of this variety is 8529 kg/ ha (Table 1). The genotype, Mahisagar (IET-22100) was tested in 20 trials conducted over 5 years at different five locations of Middle and South Gujarat (Table 1). Mahisagar was early maturing determining by its days to 50 per cent flowering i.e. 91-95 days and seed to seed maturity i.e 121-125 days. The yield attributing traits of Mahisagar viz; length of panicle (25-26 cm), panicles/sq.mt (289-299) and number of productive tillers/ plant (8-11) were found superior over both the checks (Table 2); these results are in agreement with those obtained by Sedeek *et al.* (2009). The Mahisagar culture is medium plant stature (115-125 cm, plant height) and possesses 17.0 to 17.6 gm test weight, 8.22-8.68 mm grain length and breadth 1.84-2.19 mm with kernel length/breadth (mm) ratio of 5.42/1.67, which is enough categorised in fine grain group with medium slender kernel type (Table 2). In case of diseases, bacterial leaf blight, leaf and neck blast are the major diseases of the paddy, whereas grain discoloration, sheath rot and stem rot are the minor diseases. The variety was tested for important pest and diseases of rice and showed resistance against leaf blast while moderate resistance to neck blast, bacterial leaf blight and grain discoloration (Table 5). In case of insect pests; stem borer, leaf folder and white backed hopper (WBPH) are the important pests of the paddy crop. The proposed strain showed moderate resistant reaction against stem borer, leaf folder and WBPH (Table 6). Screening of rice genotypes was carried out as per methodology suggested by Kalode

et al. (1979). The observations were recorded on the basis of 0-9 scale, when more than 90 per cent Taichung Native 1 (TN1) seedling lines were killed by the brown plant hopper insect. The whole reaction was completed in 8-14 days after the release of insects. Observations of seedlings were taken on the basis of visual plant damage symptoms (0-9 scale) which are followed by probing mark test was carried out according to methodology suggested by Natio (1964). The test was performed on 7 days old seedlings of selected resistant genotypes.

The Grain quality characteristics of the Mahisagar were derived at MRRS, Nawagam and DRR, Hyderabad which was mentioned in Table 4. The amylose content of Mahisagar in LSVT-E-F trial (K-2012 to K-2014) was analyzed and found at par in Mahisagar (25.3%) to GR-4 (25.9 %) and GR-12 (25.8 %) (Table 4). The plant type is erect with none lodging, foliage is green with strong culm, spikelet is awnless and non shattering habit and easy to thresh (Table 2). Mainly, it has found the milling quality is 71.08 per cent with head rice recovery 62.4 % (Table 3). Farmers and traders have praised the performance of Mahisagar variety. Considering the recommendation of the eleventh meeting of Combined Joint Agricultural Research Council of SAUs (SAUs Agresco, 2015) and State Variety Release Committee (SSVC, 2015), the Mahisagar approved for Gujarat state by Department of Agriculture, Co-operation and farmer welfare, Government of Gujarat, moreover, Government of India had issued notification number wide S.O.3-62 (SD-4) on 8th March, 2018 to its official Gazette.

CONCLUSION

Better quality, multiple resistances, superior yielding and early duration culture, considering the salient features, Mahisagar is well suited for commercial cultivation and farmers economy ultimately welfare of the consumers and farmers under irrigated transplanted condition eco-system in Middle and South Gujarat.

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Table 1 Comparative performance of Mahisagar and mean over locations in Middle and South Gujarat

Sr. No	Name of Expt. & Year	Location	Grain Yield kg/ha			CD @ 5%	C.V.%
			Mahisagar (IET-22100)	GR-4	GR-12		
1	IVT-IME K-2010	NWG	5079	-	5079	1003	10.9
2	AVT-I-IME K-2011	NWG	6430	-	6106	1389	11.9
3	SSVT-E K-2011	NWG	4429	2102	3754	1209	16.3
		DAB	4600	3355	4491	1000	11.2
		DAH	3680	2110	3220	877	12.0
		VYA	5610	3392	3582	754	12.0
4	AVT-II-IME K-2012	NWG	2778	-	3623	729	13.2
5	LSVT-E-F K-2012	NWG	4505	2503	4271	358	5.9
		DAB	5214	4786	5214	639	6.3
		DAH	4020	4584	3939	609	8.3
		BAR	4328	4416	4034	492	7.2
		VYA	3382	3050	2847	365	6.8
6	LSVT-E-F K-2013	NWG	5895	2932	4136	807	10.0
		DAB	3789	4046	4929	393	5.9
		DAH	2368	3444	4125	800	13.6
		BAR	2972*	2387	1678	389	9.6
7	LSVT-E-F K-2014	NWG	8529*	4444	6634	814	7.5
		DAB	4929	4060	5969	722	8.1
		DAH	4473	3678	4282	771	9.7
		BAR	4846	4462	4265	765	10.3
Over all Av.			4593	3515	4309		
Over all % Inc			6.7				
Corrs. Mean of 17 Tests							
% Inc Over checks			6.6				
Corrs. Mean of 20 Tests			4309				
Out yielded tests							
34.9							
4563							
3515			14/20				
29.8							
4593							
13/17							

NWG :Nawagam,DAB:Dabhoi, DAH:Dahod, BAR:Bardoli and VYA:Vyara; indicating significant level at 5 %*

Table 2 Grain and Morphological descriptors of Mahisagar along with check

Descriptor details	Mahisagar	GR-4	GR-12
Days to 50% flowering (days)	91-95	90-92	90-95
Maturity Days	121-125	120-125	120-125
Plant height (cm)	115-125	110-115	115-120
Panicle length (cm)	25-26	20-22	25-26
No. of productive tillers/plant	8-11	7-8	7-9

No. of filled Grains/panicle	350-375	250-275	275-300
Panicle / sq.mt.	289-299	272-279	281-290
Grain length (mm)	8.22 – 8.68	7.26-7.92	7.86 – 8.34
Grain breadth (mm)	1.84 – 2.19	1.66 – 2.21	1.57 – 1.95
1000 grain wt. (gm)	17.0-17.6	14.5-15.5	16.5-17.6
Kernel length/breadth (mm)	5.42 / 1.67	4.91 / 1.62	5.04/1.56
Panicle length	25-26 cm	20-22 cm	25-26 cm
Panicle type	Well exerted	Well exerted	Well exerted
Plant type	Erect	Erect	Erect & Open
Foliage (Green with)	Strong culm	Strong culm	Strong culm
Lodging	Non-lodging	Non-lodging	Non-lodging
Spikelet	Awnless	Awnless	Awnless
Extra glume	Absent	Absent	Absent
Grain type	Fine/MS	Fine/SS	MS
Grain classification	Fine	Fine	Fine
Cooking	Good	Good	Good
Threshability(Non shattering)	Slight hard tothresh	Easy to thresh	Hard to thresh

Table 3 Grain quality characteristics of Mahisagar, MRRS, Nawagam and DRR, Hyderabad

Sr. No	Quality Characters	Mahisagar			Mean	GR-4	GR-12
		NWG2015	DRR2011	DRR2012			
		Nawagam	Hyderabad	Hyderabad			
Physical quality of Grain							
1.	HR (%)	81.9	80.9	81.5	81.43	78.38	74.98
2.	Mill (%)	71.08	66.8	72.5	70.13	69.88	68.68
3.	HRR (%)	62.4	61.7	64.7	62.93	60.94	61.50
4.	KL (mm)	5.42	5.06	5.44	5.31	4.91	5.04
5.	KB (mm)	1.67	1.84	1.91	1.81	1.62	1.56
6.	L/B ratio	3.25	2.75	2.84	2.95	3.03	3.23
7.	Grain Chalk	VOC	VOC	VOC	VOC	VOC	VOC
8.	Grain Type	MS	MS	MS	MS	SS	MS
Cooking Quality Characters of Grain							
9.	ASV	6.0	3.0	4.0	4.0	6.0	6.0
10.	VER.	4.14	-	-	4.14	4.42	4.03
11.	KLAC (mm)	8.6	-	-	8.60	8.4	8.8
12.	KER	1.59	-	-	1.59	1.71	1.75
13.	AC (%)	24.63	21.9	23.8	23.44	25.79	26.41
14	WU (ml)	355	-	-	355	370	310
15	GC	-	44	53	49	-	-

HR-Hulling recovery, HRR- Head Rice Recovery, KL- Kernel Length, KB-Kernel Breadth, L/B- Length Breadth ratio,ASV-Alkali Spreading Value, VER-Volume expansion Ratio, KLAC- Kernel length after Cooking, KER- Kernel elongation Ratio, AC-Amylose Content, WU-Water Uptake, MS-Medium slender

NWG indicating location, Nawagam and DRR indicating *Directorate of Rice Research, Hyderabad* and MRRS indicating Main Rice Research Station

Table 4 Mean of amylose content (%) of Mahisagar during trials of Kharif -2012 to Kharif-2014

Year	Mahisagar	GR-4	GR-12
Kharif -2012	25.0	24.0	24.4
Kharif -2013	24.0	27.1	26.4
Kharif -2014	26.5	26.5	26.7
Mean	25.3	25.9	25.8

Table 5 Reactions against major diseases of paddy (unprotected field condition screening nursery)

Sr. no	Year	Variety	Location	BLB	LB	NB	ShR	GDC
1	*Kharif* 2011	Mahisagar	NWG/NVS	5/3	0	3	5/5	5/5
		GR-4	NWG/NVS	9/3	9	5	5/3	7/3
		GR-12	NWG/NVS	7/3	0	3	0/3	3/3
2	*Kharif* 2012	Mahisagar	NWG/NVS	5/3	0	3	3/3	7/5
		GR-4	NWG/NVS	9/3	9	5	9/3	9/3
		GR-12	NWG/NVS	5/3	0	0	5/3	5/5
3	*Kharif* 2013	Mahisagar	NWG/NVS	5/3	0	0	3/3	3/5
		GR-4	NWG/NVS	9/5	9	3	3/5	3/5
		GR-12	NWG/NVS	7/5	0	1	5/3	3/3
4	*Kharif* 2014	Mahisagar	NWG/NVS	5/3	0	0	3/3	3/3
		GR-4	NWG/NVS	9/3	0	0	7/3	7/3
		GR-12	NWG/NVS	7/3	0	0	7/5	7/5

Damage scale %	BLB	LB	NB	FSm	ShR	GDR
Growth Stage	4-8	3-5	8-9	7-9	7-9	8-9
0	0	0	0	0	0	0
1	>1	>5	>1	>1	>1	>1
3	1-5	>1	1-5	1-5	1-5	1-5
5	6-25	11-25	6-25	6-25	6-25	6-25
7	26-50	26-50	26-50	26-50	26-50	26-50
9	51-100	76-100	51-100	51-100	51-100	51-100

SES, IRRI, 2013, *diseases viz., LB and NB were screened at Nawagam(NWG) only; NVS=Navasari, BLB=bacterial leaf blast, LB= leaf blast,NB=neck blast,ShR=sheath rot, GDC=grain discoloration*

Table 6 Reactions of Mahisagar against major pests of paddy (unprotected field condition screening nursery)

Sr.No.	Year	Name of Variety	Location	WBPH	SB	LF
1	*Kharif* 2011	Mahisagar	NWG/NVS	3/-	1/3	3/3
		GR-4	NWG/NVS	5/-	5/5	3/3
		GR-12	NWG/NVS	5/-	1/5	3/3
2	*Kharif* 2012	Mahisagar	NWG/NVS	1/0	3/3	5/1
		GR-4	NWG/NVS	1/1	5/5	7/3
		GR-12	NWG/NVS	3/1	3/5	5/3

3	*Kharif* 2013	Mahisagar	NWG/NVS	3/1	1/5	3/3
		GR-4	NWG/NVS	3/3	3/5	5/3
		GR-12	NWG/NVS	3/3	3/5	3/3
4	*Kharif* 2014	Mahisagar	NWG/NVS	0/1	3/3	3/1
		GR-4	NWG/NVS	0/3	5/3	5/1
		GR-12	NWG/NVS	0/3	1/3	3/3

Damage scale	No. WBPH/hill	% LF damage	SB % dead hearts	White earhead	
Growth Stage	2 – 9	2 - 9	2 - 4	8 - 9	
0	0	0	0	0	
1	>5	1-10	1-20	1-10	
3	5-10	11-20	21-40	11-25	
5	11-20	21-35	41-60	26-40	
7	21-40	36-50	61-80	41-60	
9	>40	50-100	81-100	61-100	

SES, IRRI, 2013 *SB =stem borer* *WBPH=white backed plant hopper*

REFERENCES

Anonymous, 2015. Area and production of Rice, Agricultural Statistics at a Glance 2015, http://eands.dacnet.nic.in/PDF/Agricultural Statistics_At_Glance-2015.pdf PP-157

Anonymous, 2018. Area, production and productivity of rice, Directorate of Agricultural, Gandhinagar, Gujarat State, 2017-18 (First Adv. Est.) PP-1

Kalode, M.B., Krishna, T.S. and Gour, T.B. 1979. Studies on pattern of resistance to brown plant hopper (Nilaparvatalugens Stal.) in some rice varieties. *Pro. Indian. Nat. Sci. Acad.*, **44**: 43-48.

Manjappa, Uday, Gand and Hittalmani S. 2014. Association analysis of drought and yield related traits in F_2 population of Moroberekan/ IR64 rice cross under aerobic condition. *Int. J. Agril. Sci. Res.* **4** (2), 79-88.

Mistry, P. M. and Patel, P.B. 2014. Rice Research Station, Navsari Agricultural University, *Indian J. Sci. Research and Technology,* **2** (3): 56-59. Online available: http://www.indjsrt.com

Natio, A. 1964. Methods of detecting feeding marks of leaf and plant hopper and its application. Plant Protection Japan, **18** (12): 482-484.

Panse, V.G. and Sukhatme, P.V. 1969. Statistical methods for agricultural workers, Publication and information division, Indian Council of Agricultural Research, New Delhi

SAUs Agresco 2015. Combined Joint Agricultural Research Council of SAUs, held on7th -9th April, 2015, AAU, Anand.

Sedeek, SEM. Hammoud SAA, Ammar M H and Metwally, TF.2009. Genetic variability, heritability, genetic advance and cluster analysis for some physiological traits and grain yield and its components in rice (*Oryza sativa* L.). *J. Agric. Res. Kafr El-Sheikh Univ.*, **35** (3), 858-878.

SES, IRRI 2013. Standard Evaluation System (SES) for Rice P.O. Box 933, 1099 Manila, Philippines

State Variety Release Committee 2015. Proceedings of the 46th State Variety Release Committee, May, 2015, item (40), Gandhinagar, Gujarat, India.

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Evaluation of genetic variability in durum wheat (*Triticum durum* L.)

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ABSTRACT

Estimation of the variability, heritability and genetic advance in the durum wheat genotypes (*Triticum durum* L.) plays vital role in the plant breeding. Thirty durum wheat genotypes were evaluated at the Wheat Research Station, Vijapur during rabi season of 2016-2017 in a randomized block design with two replications for the estimation of the variability parameters, heritability and genetic advance. The result showed, all the genotypes exhibited wide range of variation for all the traits except for number of tillers per meter, indicating the presence of enough genetic variability in the material under study. In variability analysis of the genotypic coefficient of variation were moderate for grain yield per plot and number of grain per spike, while the estimates of phenotypic coefficient of variation were high for grain yield and moderate for number of tillers per meter, number of grain per spike and spike length. Heritability estimates were highest for days to heading, number of grain per spike, thousand grain weight, spike length, grain yield per plot and days to maturity and the Genetic advance percent of mean were highest for grain yield per plot and number of grain per spike. In the present study, result based on high variability and high heritability coupled with high genetic advance percent of mean for grain yield per plot and number of grain per spike suggesting selection for these traits would give good response.

Key words: *Triticum durum*, PCV, GCV, Heritability, Genetic advance

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Wheat is one of the most important and widely cultivated crops in the world, used mainly for human consumption and support nearly 35% of the world population (Mohammadi-joo *et al.*, 2015) and providing 20 per cent of the total food calories. Wheat is the second most important staple food next to rice. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It is known for its remarkable adoption to a wide range of environments and its role in the world economy.

Durum wheat (*Triticum durum L.*) belonging to tetraploid group, is the second most important wheat species, and widely grown in the semi-arid tropics of most parts of the world, including India. It is being cultivated in an approximate 10 to 11% of the world wheat area and accounting for about 8% of the total wheat production (Ganeva *et al.*, 2011). World production of durum wheat ranges from 30-35 million tonnes. More than 80 per cent of the total product is consumed in the country of production, with only Canada, USA and Argentina being mainly exporters. Durum wheat accounts for only 4 per cent of the total world production. Nearly 10-12 million tonnes of durum, valued around US $ 2600 million is traded annually (Singh *et al.*, 2011).

Durum wheat serves as the raw material for numerous foods, such as, macaroni, semolina and pasta products in the nourishment of world population. Normally, durum wheat has higher feeding value in terms of quality traits compared to bread wheat.

The study of genetic variability reveals about the presence of variation in their genetic constitution

and provides the basis for effective selection. Reduction in the genetic variability makes the crops increasingly vulnerable to diseases and adverse climatic changes (Aremu, 2012). Therefore, the information about degree of genetic variability and divergence present in wheat help in selecting the parents for evolving superior varieties. In successful breeding program, genetic variability play a vital role, as we know the plant with more diversity or variability has the greater chance of exploiting, to generate productive recombination and the broad sense variability in segregating generation during genetic improvement. Hence, heritability estimates provide an indication of the expected response to selection in a population. Information on the nature and magnitude of heritability in a population is one of the prerequisites for successful breeding programs in selecting genotypes with desirable characters (Amin *et al.*, 1992). There is a direct relationship between heritability and response to selection, which is referred to as genetic progress. Moreover, genetic advance estimates give a clear picture of segregating generations, to make selection effective (Saleem *et al*, 2016).

This study is aimed to estimate variability and genetic parameters, for yield and its component characters. These values will help in making effective selection for the improvement of the characters under study.

MATERIALS AND METHODS

Thirty durum wheat genotypes (Table 3) were evaluated for variability, heritability and genetic advance, for eight yield contributing traits. The experiment was conducted at the research farm, Wheat Research Station, Vijapur (latitude 23.350 N, longitude 072.550 E and altitude 126 m above sea level) in rabi season of 2016 to 2017. The annual average temperature of the study area was 31.8°C and 15.9°C with maximum and minimum temperature, respectively, with the soil type classified as sandy loam soil with a pH of 7.74. They were evaluated in randomized block design with two replications. In this experiment, each genotype was sown in four rows of 5.0 meter length and 20 cm apart, with seed rate of 120 kg/ha. Standard agronomic practices were adopted in experiment to raise a good crop. Observations were recorded at maturity, in which five plants were selected randomly from each genotype per replication for agronomic data and observations on days to heading and days to maturity were recorded on plot basis.

The analysis of variance for RBD was carried out by linear model suggested by Panse and Sukhatme (1985). The GCV and PCV, which measures the magnitude of genotypic and phenotypic variation present in a particular character, were estimated as per the formula suggested by Burton and DeVane (1953). The expected genetic advance under selection (GA) and heritability were estimated as per the formula described by Allard (1960).The genetic advance expressed as percentage of mean was computed by method suggested by Johnson *et al.*, (1955).

RESULTS AND DISCUSSION

Mean values:

For days to heading, three genotypes viz., VD 16-11, VD 16-21 and VD 16-9 showed earlier heading than other genotypes. Three genotypes viz., VD 16-13, VD 16-30 and VD 16-26 recorded more number of tillers per meter (> 80) and for spike length, the strains VD 16-19, VD 16-26 and VD 16-4 produced more spike length (> 8.5 cm) as compared to other genotypes.

For Number of grain per spike, three genotypes viz., VD 16-4, VD 16-7 and VD 16-6 recorded more number of grains per spike (> 40). Three strains viz., VD 16-22, VD 16-9 and VD 16-17 showed high thousand grain weight (> 60.0 g).

For grain yield per plot VD 16-19 recorded highest grain yield (1.828 Kg) followed by VD 16-29 (1.605 Kg) and VD 16-8 (1.598 Kg).

Analysis of variance

In present study, 30 genotypes of durum wheat were studied to assess their genetic potential. Analysis of variance (ANOVA) Table 1 for days to heading, days to maturity, plant height, spike length, number of grain per spike, thousand grain weight and grain yield per plot showed highly significant differences between genotypes indicated the presence of sufficient variability among the genotypes (Alam *et al.*, 2013; Desheva & Cholakov, 2014).

The mean values of days to heading, ranged from 51.00 to 67.00 with the mean value of 58.15, days to maturity 102.00 to 108.00 with the mean value of 105.91, plant height 50.50 to 90.25 cm with the mean value of 71.38 cm, number of tillers per meter 51.00 to 90.00 with the mean value of 70.52, spike length 6.40 to 9.30 cm with the mean value of 7.39 cm, number of grain per spike ranged from 17.00 to 51.00 with the mean value of 36.51, thousand grain weight varied from 47.80 to 65.00g with the mean value of 55.57g and grain yield per plot varied from 0.858 to 1.828 kg with the mean value of 1.220 kg. Thus, these results indicate the presence of wide range of phenotypic variability in the material.

The genotypic coefficient of variability (GCV) ranged from 1.40% for days to maturity to 19.17% for grain yield per plot, whereas, phenotypic coefficient of variability (PCV) ranged from 1.73% days to maturity to 23.00% for grain yield per plot (Table 2). The values of GCV were moderate for grain yield per plot (19.17%) and number of grain per spike (14.70%) and low for days to maturity (1.40%), plant height (5.78%), thousand grain weight (5.86%), number of tillers per meter (6.62%), days to heading (8.01%) and spike length (9.91%). The values of PCV was high for grain yield per plot (23.00%), moderate for number of tillers per meter (16.95%), number of grain per spike (16.58%) and spike length (11.78%) and low for days to maturity (1.73%), thousand grain weight (6.93%), days to heading (8.28%) and plant height (9.74%) (Table 2).

Genotypic and phenotypic coefficients of variation are used to measure the variability that exists in a given population (Abinasa *et al.*, 2011). Phenotypic coefficient of variability and GCV values of approximately more than 20% are regarded as high whereas values less than 10% are considered low and values in between are as medium (Deshmukh *et al.*, 1986).

The high PCV and moderate GCV observed for grain yield per plot and number of grain per spike and grain yield per plot are evident of their high variability that in turn it offers good scope for selection. The lowest GCV and PCV indicating difficulty of improvement for days to heading, days to maturity, plant height and thousand grain weight through selection. The value PCV were higher than GCV indicates role of environmental factors in the expression of the traits under study. These findings were in agreement with those of Gashaw *et al.* (2010), Abinasa *et al.* (2011), Desheva & Cholakov (2014), Kumar *et al.* (2014), Desheva & Kyosev (2015).

Heritability and Genetic Advance expressed as percentage of mean

In the present study heritability estimated ranged from 15.25% to 93.68 % (Table 2). High estimates of heritability (above 60%) in broad sense were recorded for six characters studied (days to heading – 93.68%, number of grain per spike – 78.59%, thousand grain weight – 71.66%, spike length – 70.76%, grain yield per plot – 69.48% and days to maturity – 65.58%). The expected genetic advance expressed as a percentage of the mean varied between 2.34% for days to maturity and 32.92% for grain yield per plot. Genetic advance as percentage of mean was high for grain yield per plot (32.92%) followed by number of grain per spike (26.85%). Genetic advance as percentage of mean was moderate for spike length (17.17%), days to heading (15.97%) and thousand grain weight (10.23%) (Table 2).

High heritability along with high genetic advance as percent of mean was noticed for number of grain per spike and grain yield per plot suggesting predominance of additive genetic effects and selection could be effective in early segregating generations for these traits and the possibility of improving durum wheat grain yield through direct selection for grain yield related traits.

High heritability along with moderate genetic advance percent of mean was noticed for days to heading, spike length and thousand grain weight suggesting predominance of additive and non-additive gene action in the expression of these traits. Therefore, these traits can be improved by mass selection. High heritability accompanied by low genetic advance percent of mean was recorded for days to maturity indicates predominance of non-additive genetic source of variation and improvement of the trait through selection may not be effective in this population, which could be exploited through heterosis breeding.

Naik *et al.* (2015) reported that high genotypic coefficient of variation along with high heritability

and genetic advance percent of mean provide better information than other parameters alone. In the present study, grain yield per plot showed high genetic advance percent of mean in conjunction with high heritability and moderate genotypic coefficient of variation (Table 2). Similar results have been reported by Ali *et al.* (2008). The knowledge on heritability of traits is helpful to decide the selection procedure to be followed to improve the trait in a situation. On the basis of results as summarized above, it is concluded that traits like grain yield per plot and number of grains per spike can be considered as suitable selection criteria for the development of high yielding durum wheat varieties.

REFERENCES

Abinasa, M., Amsalu, A., Geremew, B. 2011. Genetic variability, heritability and trait associations in durum wheat (*Triticum turgidum* L. var. durum) genotypes. *African Journal of Agricultural Research*, **6** (17): 3972-3979.

Alam, M. A., Khan, A. A., Alam, M. K., Sarker, Z. I., Rahman, M. M. 2013. Variability and diversity studies in durum wheat (*Triticum durum*). *Journal of Science and Technology*, **11**: 1-5.

Allard, R.W., 1960. Principles of Plant Breeding. John Wiley and Sons, Inc., New York.

Amin, M. R., Barma, N.C.D., Razzague, M. A. 1992. Variability, heritability, genetic advance and correlation study in some quantitative characters in durum wheat. Rachis News Letter, 11: 30-32.

Desheva, G. and Cholakov, T. 2014. Variability, heritability and genetic progress for some yield components in common winter wheat genotypes (*Triticum aestivum* L.). Genetics and Plant Physiology, Conference "Plant Physiology and Genetics – Achievements and Challenges", 24-26 September 2014, Sofia, Bulgaria, Special Issue (Part 2), 4 (3–4): 191–200.

Desheva, G. and Kyosev, B. 2015. Genetic diversity assessment of common winter wheat (*Triticum aestivum* L.) genotypes. *Emirates Journal of Food and Agriculture*, **27** (3): 283-290.

Gashaw A, Hussein M, Singh H. 2010. Genotypic Variability, Heritability, Genetic Advance and Associations among Characters in Ethiopian Durum Wheat (*Triticum durum* Desf.) Accessions. *East African Journal of Sciences*, **4** (1): 27-33.

Johnson, H.W., H. E. Robinson and R. E. Comstock. 1955. Estimates of genetic and environmental variability in soybean. *Agron. J.*, **47**: 314-318.

Kumar, N., Markar, Sh., Kumar, V. 2014. Studies on heritability and genetic advance estimates in timely sown bread wheat (*Triticum aestivum* L.). *Bioscience Discovery*, **5** (1): 64-69.

Mohammadi-joo, S., Mirasi, A., Saeidi-aboeshaghi, R. and Amiri, M. 2015. Evaluation of bread wheat (*Triticum aestivum* L.) genotypes based on resistance indices under field conditions. *Int. J. Bio. Sci.*, **6** (2): 331-337.

Naik R, Biradar S, Yadawad A, Desai S A. and Veeresha B A. 2015. Study of genetic variability parameters in bread wheat (*Triticum aestivum* L.) genotypes. *Research Journal of Agricultural Sciences*, **6** (1): 123-125,

Panse, V. G. and Sukhatme, P. V. 1985. Statistical methods for agricultural workers. (3rd Revised eds.) ICAR, New Delhi.

Saleem, B, Khan, A. S, Shahzad, M. T. and F. Ijaz. 2016. Estimation of heritability and genetic advance for various metric traits in seven F2 populations of bread wheat (*Triticum aestivum* L.), *J. Agri. Sci*, **61** (1):1-9.

Table 1 Analysis of variance for morphological characters in durum wheat

Source of Variation	d.f.	Days to heading	Days to maturity	Plant height (cm)	Number of tillers/m	Spike length (cm)	Number of grains/ spike	Thousand grain weight (g)	Grain yield/ plot (Kg)
Replication	1	0.02	2.02	0.82	608.02	0.22	294.82	31.72	0.00
Treatments	29	44.87**	5.56**	65.40*	164.70	1.29**	66.93**	25.43**	0.13**
Error	29	1.46	1.15	31.33	121.12	0.22	8.02	4.19	0.02

* and ** indicates Significant at 5% and 1% levels of probability respectively

Table 2 Genetic parameters for yield and its attributing characters in durum wheat

Variability parameters	Mean	Range		PCV (%)	GCV (%)	H^2 bs (%)	GA	GAM (%)
		Min	Max					
Days to heading	58.15	51.00	67.00	8.28	8.01	93.68	9.29	15.97
Days to maturity	105.91	102.00	108.00	1.73	1.40	65.58	2.47	2.34
Plant height (cm)	71.38	50.50	90.25	9.74	5.78	35.82	5.04	7.07
Number of tillers/m	70.52	51.00	90.00	16.95	6.62	15.25	3.75	5.32
Spike length (cm)	7.39	6.40	9.30	11.78	9.91	70.76	1.27	17.17
Number of grain/spike	36.91	17.00	51.00	16.58	14.70	78.59	9.91	26.85
Thousand grain weight (g)	55.57	47.80	65.00	6.93	5.86	71.66	5.68	10.23
Grain yield/ plot (Kg)	1.22	0.858	1.828	23.00	19.17	69.48	0.40	32.92

Table 3 Mean morphological performance of different genotypes of *T.durum* wheat

S. N.	Genotype	Characters							
		Days to heading	Days to maturity	Plant height (cm)	Number of tillers/m	Spike length (cm)	Number of grains/ spike	Thousand grain weight (g)	Grain yield/ plot (Kg)
1	VD 16-4	63	106	51.50	52.00	8.90	51	53.50	1.175
2	VD 16-5	58	107	63.25	63.00	7.50	37	53.00	1.220
3	VD 16-6	58	103	61.50	62.00	7.00	42	54.70	0.958
4	VD 16-7	64	107	50.50	51.00	7.30	43	55.60	0.858
5	VD 16-8	55	103	73.50	74.00	6.40	37	55.00	1.598
6	VD 16-9	52	106	59.75	60.00	7.20	33	64.30	1.045
7	VD 16-10	58	107	71.25	71.00	6.80	27	57.50	1.400
8	VD 16-11	51	106	66.50	67.00	6.80	34	57.80	0.910
9	VD 16-12	66	108	69.25	69.00	7.60	36	47.80	0.928
10	VD 16-13	61	106	90.25	90.00	7.20	35	52.80	1.590
11	VD 16-14	67	108	73.75	74.00	6.60	17	60.10	1.090
12	VD 16-15	56	105	77.00	77.00	7.50	30	53.80	0.990
13	VD 16-16	63	108	76.75	77.00	6.50	32	54.40	1.200
14	VD 16-17	53	104	61.50	62.00	7.30	42	61.70	0.943
15	VD 16-18	53	103	74.50	75.00	6.90	33	54.40	1.060
16	VD 16-19	56	107	81.25	81.00	9.30	40	56.80	1.828
17	VD 16-20	55	105	75.25	75.00	6.60	34	61.30	1.478

18	VD 16-21	51	104	68.25	68.00	6.90	27	56.50	1.428
19	VD 16-22	55	105	66.50	67.00	8.50	34	65.00	1.515
20	VD 16-23	65	108	74.00	74.00	6.40	28	49.90	1.118
21	VD 16-24	58	106	69.25	69.00	6.90	26	57.20	1.053
22	VD 16-25	53	103	65.25	65.00	7.70	35	56.00	1.073
23	VD 16-26	58	106	83.50	84.00	9.00	30	53.10	1.558
24	VD 16-27	53	102	70.75	71.00	7.90	40	53.00	0.928
25	VD 16-28	56	105	69.75	70.00	8.20	31	57.60	1.008
26	VD 16-29	58	105	68.25	68.00	7.50	41	53.40	1.605
27	VD 16-30	59	107	85.00	85.00	7.10	33	59.10	1.205
28	VD 16-31	55	106	60.00	60.00	7.80	42	58.90	1.200
29	GDW 1255	62	107	81.25	81.00	6.50	38	57.80	1.283
30	HI 8737	66	108	68.75	69.00	6.90	33	56.80	1.283

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Optimization of production potential of single cut forage sorghum under resources constraints

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ABSTRACT

A field experiment was carried out during Kharif season of 2016 at Sorghum research station, S.D. Agricultural University, Deesa (24.5° N, 72° E and 134 M above mean sea level) under rainfed condition to evaluate the effect of resource constraints on productivity of single cut forage sorghum. Eight treatments combinations of resource constraints viz; (1) control (only improved hybrid without any input) (2) full package of practices (FPP i.e. RDF 80 : 40 : 0 NPK kg/ha + Weed control (herbicide and weeding) + Plant protection (application of insecticide and fungicides including seed treatment with fungicides) + Seed treatment with PSB and Azospirillum + Thinning + Improved hybrid) (3) FPP without fertilizer (4) FPP without weed control (5) FPP without plant protection (6) FPP without seed treatment with PSB and Azosporillium (7) FPP without thinning and (8) FPP without improved hybrids (Local Varieties) were evaluated in randomized block design with three replications. Growing of improved hybrids or local variety with full package of practices recorded maximum fodder yield and net realizations. Fertilizer, seed treatment with PSB and azospirrilum, and plant protection were identified as most important input resources for the production of single cut forage sorghum crop

Key words: Forage sorghum, fertilizer, seed treatment, plant protection

Sorghum (*Sorghum bicolor* L. (Moench) is one of the most important grain and forage crops. It is an unique forage crop after Lucerne in the arid and semi arid tropics. It can be extensively grown during kharif and summer season mostly due to its high yielding, good palatability, better nutritive value and quick re growth after first cut particularly in multi cut sorghum variety. The production of rainy season sorghum crop is declining every year due to imbalance application of fertilizers including micronutrients, non adoption of weed management and plant protection practices, seed treatment with bio fertilizers and use of local varieties/hybrids under assured rainfall areas. Since the possibilities of horizontal expansion or putting more area under cultivation of forage sorghum is difficult, so future augmentation in yield should have to be harnessed vertically through increase in production by judicious management of input resources. Moreover, under dry land area, where shortage of input resources is a common problem, economically weak farmers forced to exclude/omit the some of the important input resources in crop for proper forage sorghum production. Therefore the present experiment was conducted to find out the resources constraints on production of single cut forage sorghum under arid and semi arid condition of north Gujarat.

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MATERIALS AND METHODS

A field experiment was carried out during kharif season of 2016 at Sorghum research station, S.D. Agricultural University, DEESA (24.5° N, 72° E and 134 M above mean sea level) under rainfed condition to evaluate the effect of resource constraints on productivity of single cut forage sorghum. The experiment site has loamy sand soil with pH (7.85), organic carbon (0.26 %), available nitrogen (145.2

kg/ha), medium in available phosphorus (29.2 kg/ ha) and available potassium (288 % kg/ha). Eight treatments combination of resource constraints viz; (1) control (only improved hybrid without any input) (2) full package of practices (FPP i.e. RDF 80 : 40 : 0 NPK kg/ha + Weed control (herbicide and weeding) + Plant protection (application of insecticide and fungicides including seed treatment with fungicides) + Seed treatment with PSB and Azospirillum + Thinning + Improved hybrid) (3) FPP without fertilizer (4) FPP without weed control (5) FPP without plant protection (6) FPP without seed treatment with PSB and Azosporillium (7) FPP without thinning and (8) FPP without improved hybrids (Local Varieties) were evaluated in randomized block design with three replications. The recommended dose of fertilizer for sorghum was 80:40:00 N, P_2O_5 and K_2O. Half dose of nitrogen and full dose of phosphorus and potassium was applied as basal and remaining half dose of nitrogen was applied 30 days after sowing. Hybrid forage sorghum CSH 13 and local variety GFS 5 was sown at a distance of 30 cm on 22, July, 2016 with a 20 kg per hectare seed rate by drilling methods. There was no much variation in weather like relative humidity, maximum and minimum temperature during the crop growth period. During the period of study, the relative humidity varied from 31.71 to 90.00 % and minimum temperature 14.74 to 28.53 c^0 and maximum temperature from 29.30 to 37.20 c^0. The total rainfall 449 mm was received during the cropping period having 208 mm in the month of July and 183 mm in the month of August. The forage sorghum crop was harvested at 50 % flowering stage (i.e. 71 DAS). The growth, yield and yield attributes parameters of forage sorghum were recorded from the net plot and yield was converted in to hectare basis. The green and dry fodder productivity was calculated by following formula.

$$\text{Green/Dry fodder productivity (kg/ha/day)} = \frac{\text{Green/Dry fodder yield (kg/ha)}}{\text{Total crop duration (Days)}}$$

The economics were calculated based on the prevailing market prices of inputs and outputs. The data of the experiment was statistically analyzed by using OPSTAT software design by HAU, Hisar.

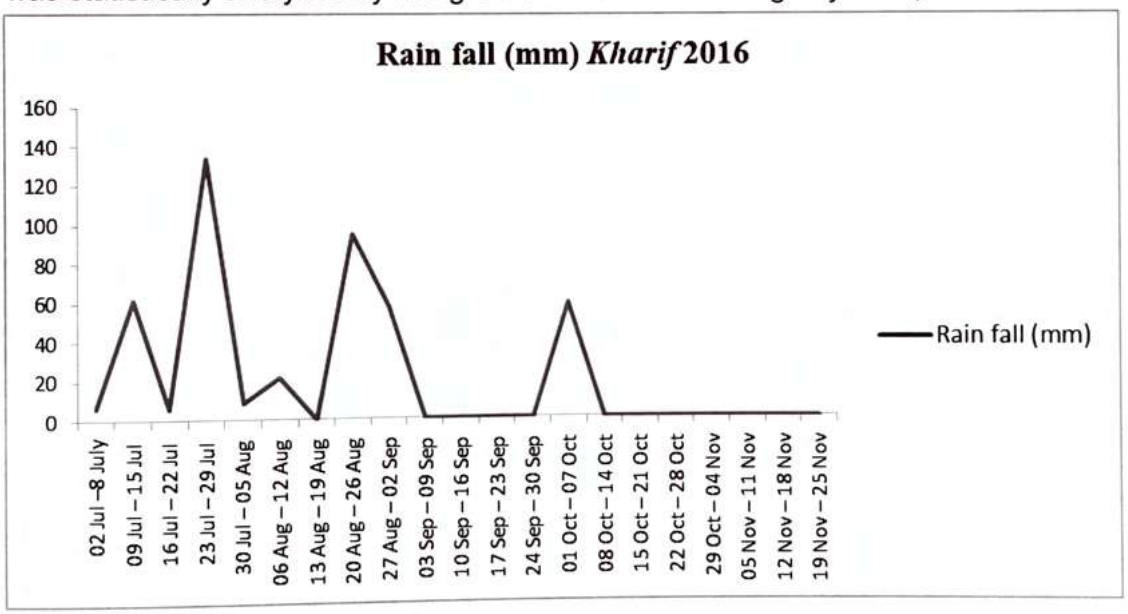

Fig.1. Weekly rainfall distribution during kharif season 2016.

RESULTS AND DISCUSSION

Significant effect of different treatments of resources constraints were observed on plant height, stem diameters, green and dry fodder yield and their productivity per days. (Table: 1) The growth parameters viz; plant height and stem diameter were found significantly taller / higher with the adoption of full package of practices (FPP) under improved varieties as compared to control treatments. The growth of improved forage sorghum crop with full package of practices i.e. without any resources constraints recorded taller/ higher plant and it was closely followed by growing of local variety without any resource constraints by recording 103.75 and 97.34 % taller plant than

control treatments, respectively. The response of omitting the plant protection, seed treatments with PSB and azospirillum, weed management and thinning was recorded more of less equal plant height. The omission of fertilizer to single cut forage sorghum crop drastically reduced the plant height. This might be due to the better growing conditions to fully exploit the gentle potentiality of the improved variety of the sorghum crop.

The stem diameter was markedly influenced by different resources constraint treatments. Significantly the highest stem diameter was recorded by the application of full package of practices to the improved hybrid and it was found equally effective to the local cultivars of the forage sorghum crop. The omission of the resources constrains like weed control, plant protection and thinning were found equally effective for stem diameter growth. Thus difference in growth of forage sorghum might be attributed to their genetically constitution.

The productivity of forage sorghum per day was markedly influenced by different treatment of resource constraints. The green and dry fodder productivity per day of forage sorghum was significantly highest when improved sorghum hybrid was grown without any resources constraints and it was closely followed by local variety without any resources constraints. The response of omission of weed control, plant protection, seed treatments and thinning did not reduced the productivity of the forage sorghum crop but the omission of fertilizers resources drastically reduced the productivity of the forage sorghum crop. The growing of improved hybrids of forage sorghum without any resource constraints recorded significantly highest green and dry fodder yield and which was to the tune of 196.6 and 337.4 per cent higher than control treatments but it was at par with the FPP without thinning treatment. Moreover sowing of improved hybrid with seed treatment of PSB + azospirillum, without omission of plant protection and weed control expressed more or less equal green and dry fodder yield. The higher green and dry fodder yield might be due to higher plant height and stem diameter under this treatments. Abdullani *et al.* (2016) also found more or less similar results. The maximum reduction in green and dry fodder yield were observed under control treatment and it was followed by omission of fertilizers.

Economics

The economic parameters of the fodder sorghum was calculated on the basis of prevailing market prices of inputs and outputs (Table : 2). The maximum gross return, net return and benefit cost ratio was obtained when the improved hybrids of the sorghum crop was grown without omission of the resource constraints Consequently the owing of improved hybrid with full package of practices recorded higher percentage increase in green and dry fodder yield over control followed by FPP without thinning and FPP without weed control. This was because of higher production potential of forage sorghum crop under favourabl resource constraints. Lowest net realization and benefit cost ratio was recorded under FPP without seed treatment with PSB and azospirillum and FPP without fertilizers.

Based on the present results, it can be concluded that growing of improved hybrids or local variety with full package of practices recorded maximum fodder yield and net realizations. Fertilizer, seed treatment with PSB and azospirillum, and plant protection were identified as most important input resources for the production of single cut forage sorghum crop

REFERENCES

Abdullahi, S., Ghosh, Gautam and Dawson, Joy. 2016. Effect of different weed control methods on growth and yield of maize (*Zea Mays* L.) under rainfed condition in Allahabad. IOSR *Journal of Agriculture and Veterinary Science*, **9** (4): 44-47.

Kausalye, S. P., Aundhekar, R. L., Solunke, S. S. and Kalpande, H. V. 2017. Optimisation of production factors in Rabi grain sorghum under resource constraints. Agriculture Update, **12**: 1201-1203.

Mondal, Tanushree, Datta, Jayanta Kumar and Mondal Naba Kumar. 2017. Chemical fertilizer in conjunction with biofertilizer and vermicompost induced changes in morpho-physiological and bio-chemical traits of mustard crop. *Journal of the Saudi Society of Agricultural Sciences*, **16** (2): 135-144.

Pathak, P. K., Singh, S. K., Sahay, C. S., Sharma, R. K., Chaudhary, Manoj and Maity, A. 2016. Compendium of lecture notes of summer school on "Recent approaches in crop residue management and value addition for entrepreneurship development" from July 14 - August 03, 2016. ICAR- Indian Grassland and Fodder Research Institute, Jhansi, (U.P.) 284003- India, p. 263.

Table 1 Yield and yield attributes of single cut forage sorghum as influenced by different resource constraints

Tr. No.	Treatments	Plant height (cm)	Stem diameter (cm)	Fodder Yield (t/ha)		Productivity (kg/ha/day)		Per cent yield increase over control	
				Green	Dry	Green	Dry	Green	Dry
1	Control (only improved hybrid without any input)	97.80	3.14	16.93	7.91	238.45	70.34	-	-
2	full package of practices (FPP)	199.27	4.24	50.21	34.60	707.19	307.63	196.6	337.4
3	FPP without fertilizer	99.73	3.90	35.05	18.32	493.64	162.90	107.0	131.6
4	FPP without weed control	182.73	4.17	41.40	27.54	583.06	244.89	144.5	248.2
5	FPP without plant	188.07	4.14	36.30	23.57	511.27	209.62	114.4	198.0
6	FPP without seed treatment with PSB and Azosporillium	186.60	3.77	32.81	22.24	462.07	197.77	93.8	181.2
7	FPP without thinning	177.60	4.09	46.72	31.30	657.99	278.33	176.0	295.7
8	FPP without improved hybrids (i.e. Local Varieties)	193.00	4.20	40.97	27.97	577.07	248.72	142.0	253.6
	SEm±	7.05	0.11	2.12	0.93	29.80	11.64		
	CD (5%)	15.26	0.23	4.58	2.83	64.53	25.20		

Table 2 Economics of single cut forage sorghum as influenced by different resource constraints

Tr. No.	Treatments	Green fodder yield (t/ha)	Dry Fodder Yield (t/ha)	Gross return (10^3 Rs/ha)	Net return (10^3 Rs/ha)	BCR
1	Control (only improved hybrid without any input)	16.93	7.91	42.32	27.52	1.86
2	Full package of practices (FPP)	50.21	34.60	125.53	100.27	3.97
3	FPP without fertilizer	35.05	18.32	87.62	65.40	2.94
4	FPP without weed control	41.40	27.54	103.49	81.36	3.68
5	FPP without plant	36.30	23.57	90.75	68.38	3.06
6	FPP without seed treatment with PSB and Azosporillium	32.81	22.24	82.02	56.96	2.27
7	FPP without thinning	46.72	31.30	116.79	92.73	3.85
8	FPP without improved hybrids (i.e. Local Varieties)	40.97	27.97	102.43	78.67	3.31
	SEm±	2.12	0.93	5.29	5.29	0.27
	CD (5%)	4.58	2.83	11.45	11.45	0.58

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Problems perceived by the livestock owner regarding rearing of Kankrej cow

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ABSTRACT

Dairy farming has been part of agriculture for thousands of years. Historically, it has been one part of small, diverse farms. Gujarat is the leading state in milk production and its AMUL pattern of cooperative was adopted in the world. The unique characteristics of kankrej cow like resistant to tick fever, heat stress, very little incidence of contagious abortion and tuberculosis madea very popular one among these countries. Three talukas of Banaskantha District viz,.Deesa, Lakhani and Deoder and three talukas of Patan District viz.; Radhanpur, Sami and Harij were selected purposively having highest population of Kankrej cow and breed is popular in the study area. Three villages from each taluka were selected randomly. Further ten farmers having kankrej cow from each village were selected randomly, consist a sample of 180 farmers for the study. Maximum number of livestock owner were middle to old aged, literate, having more than 5 members in family, small to medium land holding, small to medium herd size, having milking Kankrej cow, agriculture as a primary occupation, sources of information for Animal Husbandry practices were milk cooperative society as a formal source, friends/relatives/neighbor/progressive farmers as an informal sources and television/ newspaper/krushimahotsav as a mass media. More than ninety per cent livestock owner were members in milk cooperative society, having medium milk yield (3.01 to 39.15 liter/day) of herd kept by him, had less than 0.50 hectare land under forage crops.The major problem perceived by the livestock owner in rearing of kankrej cow were; non availability of high pedigree bull, lack of knowledge about clean milk production, low conception rate through A.I, lack of scientific management practices and more problem related to mastitis.

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Dairy farming has been part of agriculture for thousands of years. Historically, Dairy farming has been one part of small, diverse farms. Kankrej, famously known as Guzerat in Brazil, is being maintained in large numbers as a pure breed in the country. The Guzerat was the most important breed in the formation of American Brahman. The unique characteristics like resistant to tick fever, heat stress, very little incidence of contagious abortion and tuberculosis made kankrej a very popular one among these countries. The cows are good milkers and bullocks are used for agricultural operation and road transport. Kankrej is the local breed famous for its dual purpose. It takes its name from the name of geographical area i.e. Kankrejtaluka of Banaskantha district in Gujarat. The total cowmilk yield on an average 2750 kilo grams and a maximum of 6200 kilo grams per lactation. Selected cows have produced around 1750 Kg at village condition. (Anonymous, 2016). SDAU started the Kankrej breed improvement programme since last decade and very good results have been received as milking animals. Hence, it is advisable for the farmers to keep cows instead of crossbred cow.

OBJECTIVES

1). To know the profiles of the farmers

2). To identify problems perceived by the farmers regarding rearing of Kankrej cow

METHODOLOGY

This study was conducted in Banaskantha and Patan District of Gujarat State. Three talukas of Banaskantha district viz,. Deesa, Lakhani and Deoder and three talukas of Patan district viz.; Radhanpur, Sami and Harij were selected purposively having highest population of Kankrej cow and breed is popular in the study area. Three villages from each taluka were selected randomly. Further ten farmers having kankrej cow from each village were selected randomly. Thus sample size of the present study was 180 livestock owner. The data were collected through the use of structured interview schedule. The farmers were interviewed personally and their responses were recorded. The data were tabulated and interpreted on the basis of frequency, percent, mean and standard deviation.

RESULTS AND DISCUSSION

PROFILE OF THE FARMERS

The personal, social, economic and situational characteristics of Kankrej cow owners were calculated on the basis of frequency and percent and depicted in Table 1.

Table 1 Distribution of the livestock owner according to their characteristics (N= 180)

Sr. No	Character	Frequency	Percentage (%)
01	Age		
	Young (Up to 35 years)	18	10.00
	Middle (36 to 50 years)	117	65.00
	Old (Above 50 years)	45	25.00
02	Level of education		
	Illiterate	05	02.78
	Primary (up to VIII)	48	26.67
	Secondary (IX to X)	92	51.11
	Higher Secondary (XI to XII)	27	15.00
	College	08	04.44
03	Family size		
	Up to 4 member in Family	36	20.00
	5 to 6 member in Family	94	52.22
	Above 7 member in Family	50	27.78
04	Land holding		
	Marginal (Below 1.0 ha)	26	14.44
	Small (1.01 to 2.0 ha)	57	31.66
	Medium (2.01 to 4.0 ha)	67	37.22
	Big (Above 4.0 ha)	30	16.66
05	Herd size		
	Small size herd (up to 5 animals)	67	37.22
	Medium size herd (5 to 10 animals)	87	50.00
	Large size herd (above 10 animals)	26	12.78
06	Occupation		
	Primary: Agriculture and Secondary: Dairy farming	160	88.89
	Primary: Dairy farming and Secondary: Agriculture	20	11.11

07	Sources of information		
	Formal sources		
	Village level workers/Agricultural Extension Officer	36	20.00
	Milk cooperative society	168	93.33
	Agriculture University Officer/ Scientist	73	40.55
	Private Dealers	14	07.77
	Others	06	03.33
	Informal sources		
	Friends	152	84.44
	Neighbors/Relatives	168	93.33
	Progressive Farmers	162	90.00
	Others	11	06.11
	Mass media		
	Television	156	86.66
	Radio	40	22.22
	News paper	142	78.88
	KrishiMahotsav/Agriculture Fair	134	74.44
	Magazine	48	26.66
	Internet	25	13.88
08	Social participation		
	No membership	12	06.66
	Membership in one organization	148	82.23
	Membership in more than one organization	20	11.11
	Holding position	28	15.55
09.	Total Milk Production (Liter/ day)		
	Low milk yield (< 3.01)	03	01.66
	Medium milk yield (3.01 to 39.15)	165	91.67
	High milk yield (> 39.15)	12	06.67
	Mean=21.08	SD=18.07	
10.	Area under forage crop		
	Less than 0.50 hectare	102	56.67
	Between 0.50 to 01.00 hectare	56	31.11
	More than 01.00 hectare	22	12.22

Ha = hectare, N= number of observation, SD = Standard Deviation

The data regarding selected characteristics of livestock owner are presented in Table 1 indicate that 90.00 per cent of them were middle and old aged, almost all (97.22 per cent) were literate i.e. educated up to primary to college level and 80.00 percent farmers had more than five (5) member in the family.

Further, more than two third (68.88 per cent) of them had small to medium size of land holding, possess small to medium size of herd (87.22 per cent) and having primary occupation agriculture and secondary occupation dairying (88.89 per cent). The main formal sources of information was milk cooperative society (93.33 per cent), informal sources were Neighbours/Relatives (93.33 per cent), Progressive farmers (90.00 per cent) and Friends (84.44 per cent), whereas, in mass media Television (86.66 per cent), Newspaper (78.88 per cent) and Krishimahotsav/Agriculture fair (74.44 per cent) were important sources of information. Whereas, 82.23 per cent farmers were member in one organization, produced medium milk per day i.e.; 3.01 to 39.15 litre (91.67 per cent) and 87.78 per cent farmers having less than 1.00 hectare area under forage crops.

The finding is in line with findings of Parag (2015) and Pakhmode *et al.* (2017)

PROBLEMS PERCEIVED BY THE LIVESTOCK OWNERS REGARDING REARING OF KANKREJ COW

The data in Table 2 show that most important problem perceived by the farmers in rearing of kankrej were; non availability of high pedigree bull (91.66 per cent), lack of knowledge about clean milk production (84.44 per cent), low conception rate through A.I (81.11 per cent) and lack of scientific management practices of kankrej cow (80.00 per cent) were ranked first, second, third and fourth. Whereas, important problems were; more problem related to mastitis (62.22 per cent), poor economic condition (53.88 per cent) and tedious process of availing credit (52.77 per cent) were ranked fifth, sixth and seventh. While least important problems were; high cost of veterinary services (25.00 per cent), inadequate veterinary services (16.11 per cent) and low milk yield (06.66 per cent) were ranked eighth, ninth and tenth.

Table 2 Problems perceived by the farmers regarding rearing of kankrej (n=180)

Sr. No	Problems	Frequency	Per cent	Rank
1	Non availability of high pedigree bull	165	91.66	I
2	Lack of knowledge about clean milk production	152	84.44	II
3	Low conception rate through A.I	146	81.11	III
4	Lack of scientific management practices	144	80.00	IV
5	More problem related to mastitis	112	62.22	V
6	Poor economic condition	97	53.88	VI
7	Tedious process of availing credit	95	52.77	VII
8	High cost of veterinary services	45	25.00	VIII
9	Inadequate veterinary services	29	16.11	IX
10	Low milk yield	12	06.66	X

It can be concluded that major problem perceived by the farmers in rearing of kankrej were; non availability of high pedigree bull, lack of knowledge about clean milk production, low conception rate through A.I, lack of scientific management practices of kankrej cow and more problem related to mastitis.

CONCLUSION

1. Maximum number of livestock owners were middle to old aged, literate, having more than 5 members in family, small to medium land holding, small to medium herd size, having milking Kankrej cow, agriculture as a primary occupation, sources of information were milk cooperative society, informal sources were friends /relatives/ neighbor/ progressive farmers) and television/ newspaper/ krushimahotsav as a mass media. More than ninety per cent farmers were members in milk cooperative society, having medium milk yield of herd kept by him,had less than 0.50 hectare land under forage crops.
2. The major problem perceived by the farmers in rearing of kankrej were; non availability of high pedigree bull, lack of knowledge about clean milk production, low conception rate through A.I, lack of scientific management practices and more problem related to mastitis.

REFERENCES

Anonymous, 2016. Agresco report of Animal Production sub-committee, College of Veterinary Science and Animal Husbandry, SDAU, Sardarkrushinagar

Pakhmode, P.S., Rathod, M.K. and Bhagat, M.C. 2017. Attitude of rural youth towards farming as a major occupation. *International Journal of Chemical Studies*, **6** (1): 1735-1738.

Parag, P.S. 2015. Attitude of rural youth towards farming as a major occupation. M.Sc. (Agri.) Thesis (Unpublished). Dr. Panjabrao Krishi Vidyapeeth, Akola, Maharashtra State.

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Effect of spacing and fertility levels on growth and yield of carrot (*Daucus carrota L.*) cv. GDC 1

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ABSTRACT

Carrot is one of the major vegetable crops grown throughout the world and considered to be an important economical vegetable as it has large yield per unit area. The inclusion of carrots in human diet is highly appreciated due to high nutritional and positive impact on human health and immunity systems. This is cheaply available and is equally consumed by poor and rich people in India. The popularity of carrot is increasing day by day due to its high nutritive values and adaptability in diversified agriculture. Plant spacing is one of the important factors for the increased production of carrot. To augment the potential yield of carrot, nutrient management plays a vital role. Different types of fertilizer affect the yield and nutritional quality of carrot. Crop sown at 15 and 30 cm row spacing recorded statistically an equal root length but significantly longer than broadcasting. Carrot sown at 30 cm row spacing confirmed significantly the maximum root girth and it was the lowest when carrot sown by broadcasting. Application of 80 % RDF recorded the maximum root length as well as girth and was at par with 100 % RDF but these both the levels were significantly superior to the maximum fertility level i.e. 120 % of RDF. Both the line sowings were at par and recorded significantly higher root yield than broadcasting on pooled basis. Application of 80 % RDF recorded the significantly the maximum root yield of carrot and remain at par with 100 % of RDF. The root weight augmentation could be due to the increased vegetative growth and hence increased food production and assimilation into parts. But with excess application of N-fertilizer more of above ground vegetative growth is favored than root growth, so that low root weight could result at higher level of N fertilizers. However, narrow spacing and higher fertility levels increased fodder yield. Application of 80% RDF recorded the maximum gross (Rs.2,12,800/ha) and net profit (Rs.1,67,588/ha) as well as BCR (3.71) values.

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Carrot (*Daucus carota L.*) is one of the most important root vegetables of both tropical and temperate countries. It produce an enlarge fleshy taproot that is edible and possesses high nutritive value. The popularity of carrot is increasing day by day due to its high nutritive values and adaptability in diversified agriculture. Carrot is used as salad, cooked as vegetables preferably with potatoes and peas. Carrot juice is becoming popular day by day. A special type of beverage known as kanji is prepared from black carrot and used as appetizer. It is used in making pickles and sweets. Orange coloured roots of carrot contain more carotenes than red colored type and rich in thiamine and riboflavin.In north Gujarat region, the farmers of patan taluka widely grown carrot. Sowing time and spacing are non cash inputs for remunerative production of carrot. Plant spacing is one of the important factors for the increased production of carrot. Carrot yield is also adversely affected by planting density. McCollum *et al.* (1986) reported that there is positive correlation between the number of plants and yield of carrot. But many workers have reported that different plant densities have different effect for marketable yield of carrot (Dragland, 1986). Soils of North Gujarat are light in texture which is in generaly poor in fertility and water holding capacity. To augment the potential yield of carrot, nutrient management plays a vital role. The cost of chemical fertilizer has been enormously increasing to an extent that they are out of reach of

the small farmers. Different types of fertilizer affect the yield and nutritional quality of carrot. Nitrogen (N) is not only an important element for the growth of but carrot but it also affects the nutritional quality of the carrot roots (Kansal, 1981). No scientific information for the region on these aspects regarding newly developed variety i.e. GDC 1. Hence, an experiment was planned at SSRS, SDAU, Jagudan to evaluate the optimum spacing and nutrient requirement of carrot cv.GDC 1.

MATERIALS AND METHODS

To find out the effect of spacing and fertility levels on growth, yield and quality of carrot (*Daucus carrota L.*) cv. GDC 1, an investigation was carried out at Seed Spices Resarch Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan during rabi 2014-15 to 2016-17. Soil texture was loamy sand in nature with low in organic carbon (0.18 %) and nitrogen as well as medium in available phosphorus and potassium. Two factors viz., spacing: 15 cm, 30 cm and broadcasting as well as fertility levels: 80 % RDF, 100 % RDF and 120 % RDF were studied and laid out in Factorial Randomized Block Design with three replication. The carrot seeds were sown manually at about 2-3 cm deep in furrow for line sowing and spread by hand in broadcasting method. The entire quantity of phosphorus and half of nitrogen in the form of DAP and urea were manually applied as basal dose. All the recommended package of practices was performed during the crop period as per need.

RESULTS AND DISCUSSION

Growth and yield attributes:

Effect of spacing

As compared to broadcasting, line sowing improved the growth and yield attributes of carrot significantly except number of tillers per plant (Table 1) on pooled data basis. The tallest plants were recorded with 15 cm spacing and was at par with broadcasting these both were significantly superior when carrot sown at 30 cm row spacing. Crop sown at 15 and 30 cm row spacing recorded statistically an equal root length but significantly longer than broadcasting. Carrot sown at 30 cm row spacing recorded significantly the maximum root girth and it was the lowest when carrot sown by broadcasting method. This might be because the wider spacing reduced the competition for soil nutrients, moisture, carbon dioxide and light among the plants. This probably enhanced photosynthesis which resulted in the production of more leaves and wider canopies. This result is in agreement with the results of Appiah *et al* (2017) reported that wider spacing i.e. 25 cm improved the vegetative growth and yield attributes of carrot.

Effect of fertility levels

Only root length and girth were significantly influenced by various fertility levels. Application of 80 % RDF recorded the maximum root length as well as girth and was at par with 100 % RDF but these both the levels were significantly superior than the maximum fertility level i.e. 120 % of RDF (Table 1). This might be due to the balanced supply of plant nutrients which provided better soil condition for more vegetative growth and development. Interaction effect between spacing and fertility levels was found non significant on growth and yield attributes of carrot.

Root and fodder yields

Effect of spacing

Both the line sowings were at par and recorded significantly higher root yield than broadcasting on pooled basis (Table 1). The widely spaced plants produced longer roots than the closely spaced plants. This might be due to reduced competition for essential soil nutrients and sunlight which probably promoted the accumulation of photosynthates in the roots. Norman (1992) observed that higher plant density per unit area or closer spacing increases the competition for essential growth factors among individual plants which do not attain their normal size. However, fodder yield was not influenced significantly by varying spacing treatments (Table 1).

Effect of fertility levels

On pooled data basis, increase in each

fertility levels from 80 to 120 % RDF decreased root yields significantly. Application of 80 % RDF recorded the significantly the maximum root yield of carrot and remain at par with 100 % of RDF (Table 1). Tanveer Ahmad *et al.* (2015) reviewed briefly the scope of application of chemical fertilizers for sustainable productivity and quality of carrot roots. The current result conform the indirect effect of N-fertilization for increased root weight in carrot. The root weight augmentation could be due to the increased vegetative growth and hence increased food production and assimilation into parts. But with excess application of N-fertilizer more of above ground vegetative growth is favored than root growth, so that low root weight could result at higher level of N fertilizers. Neither spacing nor fertility levels had positive effect on fodder yield during individual as well as on pooled data basis. However, narrow spacing and higher fertility levels increased fodder yield (Table1).The increase in carrot fodder yield might be attributed to excess N- fertilizer application could be associated with the enhanced vegetative growth of carrot rather than root development (Wudiri and Henderson,1985).

ECONOMICS

The maximum gross realization of Rs. 2,04,400 Rs/ ha and net income Rs.1,56,891 /ha were obtained when carrot sown at 15 cm row spacing and closely followed by 30 cm spacing,but 30 cm row spacing recorded the maximum BCR value i.e. 3.32 (Table 4).Application of 80% RDF recorded the maximum gross (Rs.2,12,800/ha) and net profit (Rs.1,67,588/ ha) as well as BCR (3.71) values(Table 2). From these results it can be concluded that cultivar GDC 1 performed better when sown at 30 cm row spacing with application of 80 % RDF i.e. 80:40:40 kg NPK/ ha for getting the maximum root yield and net profit.

CONCLUSION

From the study, it can be concluded that carrot variety GDC 1 grown at 30 cm row spacing with 80 % RDF i.e. 80:40:40 kg NPK/ha for getting the maximum root yield and net profit.

REFERENCES

Appiah, F. K., Sarkodie-Addo, J. Opoku A. 2017. Growth and yield response of Carrot (*Daucus Carota* L) to different green manures and plant spacing. *Journal of Biology, Agriculture and Healthcare*. **7**, 20.

Dragland, S. 1986. Plant density and row spacing in Carrots. Forskingsstasjon kise, Norway. 37:3, 139-145.

Kansal, B.D., B. Singh, K.L. Bajaj and G. Kaur.1981. Effect of different levels of nitrogen and farmyard manure on yield and quality of spinach (*Spinacea oleracea* L.). *Plants food for Human Nutrition*. **31** (2): 163-170.

McCollum, T.G., S.J. Locascio and J.M. White 1986. Plant density and row arrangement effects on carrot yield. *J. Amer. Soc. Hort. Sci.* **111** (5): 648-651.

Norman, J. C. 1992. Tropical Vegetables Crops. Arthur, H. Stockwell Ltd. Elms Court Ilfracombe, Devon, UK, pp 232.

Tanveer Ahmad, Muhammad Sohail Mazhar, Haider Ali, Asmat Batool a Waqas Ahmad 2017. Efficacy of fertilizer management on carrot productivity and quality (Review) Sci. Int. (Lahore) **27** (5).

Wudiri, B. B. and D. W. Henderson 1985. Effects of water stress on flowering and fruit set in processing tomatoes. *Scientia Horticulturae*, **27**: 189–198.

Table 1 Growth and yield attributes and yields of carrot as influenced by different spacings and fertility levels (Pooled data)

Sr. No.	Treatment	Plant height (cm)	No. of tillers per plant	Root length (cm)	Root girth (cm)	Carrot root yield (t/ha)	Carrot fodder yield (t/ha)
		Spacing					
1	15 cm	65.4	7.8	21.3	12.7	29.2	11.8
2	30 cm	60.2	7.9	20.8	13.2	28.4	11.3
3	Broadcasting	63.6	7.6	19.6	12.1	26.1	11.4
	S. Em.	0.8	0.1	0.26	0.15	0.47	0.16
	C. D. @5%	2.3	NS	0.7	0.44	1.33	NS
	C.V.%	6.9	6.1	6.4	6.3	8.7	7.3
		Fertility levels					
1	80 % RDF (80:40:40 NPK kg /ha)	63.8	7.8	21.1	13.1	30.4	11.0
2	100 % RDF (100: 50:50 NPK kg /ha)	62.0	7.8	21.0	12.9	27.5	11.7
3	120 % RDF (120: 60:60 NPK kg /ha)	63.4	7.7	19.5	12.0	25.8	11.9
	S. Em.	0.8	0.1	0.26	0.15	0.47	0.16
	C. D. @5%	NS	NS	0.7	0.44	1.33	NS
	C.V.%	6.9	6.1	6.4	6.3	8.7	7.3
Interaction (S x F)		NS	NS	NS	NS	NS	NS

Table 2 Economics of carrot as influenced by different spacing and fertility levels

Sr. No.	Treatment	Root yield (t/ha)	Gross realization (Rs/ha)	Cost of cultivation (Rs/ha)	Net Realization (Rs/ha)	BCR
		Spacing				
1	15 cm	29.2	2,04,400	47,508	1,56,891	3.30
2	30 cm	28.4	1,98,800	46,064	1,52,735	3.32
3	Broadcasting	26.1	1,82,700	47,508	1,35,191	2.85
		Fertility levels				
1	80 % RDF (80:40:40 NPK kg /ha)	30.4	2,12,800	45,212	1,67,588	3.71
2	100 % RDF (100: 50:50 NPK kg / ha)	27.5	1,92,500	46,064	1,46,435	3.18
3	120 % RDF (120: 60:60 NPK kg / ha)	25.8	1,80,600	46,917	1,33,683	2.85

Selling price of carrot: Rs.7/kg

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Evaluation of bio-efficacy of tebuconazole 25 WG against alternaria blight and powdery mildew diseases of cumin

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ABSTRACT

Blight and powdery mildew are very destructive diseases of cumin and they may cause complete failure of crop, if proper and timely precautionary measures are not taken. For the effective and economic management of cumin blight and powdery mildew, field trial was undertaken during rabi 2014-15 and rabi 2015-16 to determine the effectiveness of tebuconazole 25 WG against blight and powdery mildew on cumin. Different eight treatments with their prefixed concentrations were compared with control. On the basis of the two years of investigation it has been concluded that tebuconazole 25 WG @ 750 g/ha was found effective against Alternaria blight (*Alternaria burnsii*) and powdery mildew (*Erysiphe polygoni*) diseases of cumin with increase in the yield. Higher dose of tebuconazole 25 WG @ 1500 g/ha did not produce any phytotoxic symptoms on cumin crop at different crop stages during sprays. This indicated that tebuconazole 25 WG is non-phytotoxic to cumin crop.

Key words: Cumin, Alternaria blight, Powdery mildew disease management

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Cumin (*Cuminum cyminum*) is grown in India on large scale besides several other countries like Bulgaria, Egypt, Argentina, Turkey, Bangladesh, Iran, China, Italy, Pakistan etc. It is an important crop of Rajasthan and Gujarat and some adjoining states. Therefore it is known as Bowl of seed spices. During 2016-17, cumin was grown in 7.60 lakh ha with 4.86 lakh T production and 0.64 T per ha productivity in India, where as, in Gujarat cumin was grown in 2.79 lakh ha with 2.91 lakh T production and 1.05 T per ha productivity (Anon, 2017). It is exported to many countries including Bangladesh, Japan, Malaysia, Nepal, Pakistan, Singapore, USA etc. Its value added products viz., oleoresins, oils etc. are exported to USA, UK, Germany etc. Demand of cumin seed as whole or as value added products increased in many fold during recent past but main constraint for export is only pesticides residues. Cumin seeds contain 2.5-4.0% volatile oil, aldehydes, cuminol which attributes to its medicinal properties. The crop is subjected to many pathogens causing diseases which negatively influence the yield (Dange, 1995 and Sharma *et al.*, 2010). In cumin-growing districts of Rajasthan and Gujarat, incidence of wilt (*Fusarium oxysporum f.sp. cumini*), blight (*Aternaria burnsii alte.*), and powdery mildew (*Erysiphe polygoni*) are in moderate to severe form. (Sharma *et al.*, 2013)

Blight (*Aternaria burnsii alte.*) was reported first time in Gujarat by Uppal *et al.* (1938). Now, it is a common disease in all the cumin growing areas favored by humid and cloudy weather. Small necrotic spots develop on all the aerial parts which enlarge, coalesce and turn brown to black. Under humid conditions stem and flowers are also infected which may be killed. Either seeds are not formed on diseased plants or produced they remain small, shriveled, and blackish. 23-28°C temperature is optimum for disease development (Ghemawat and Prasad, 1972). The powdery mildew disease caused by Erysiphe polygoni DC reduced seed yield up to 50 per cent under favourable weather conditions. Under severe disease condition, the total failure of the crop has been observed (Champawat and Singh, 2008). As there is no resistant variety available against the disease, it has become inevitable to go for the use of fungicides for the management of

diseases. Few fungicides were reported earlier for the management of disease by Akbari *et al.*(1996), Solanki *et al.* (1973), Patel N.R (2011), Dange *et al.* (2012) ,Sharma *et al.* (2013) and Patel *et al.* (2017) but under favorable environmental conditions the disease is still causing severe yield losses as well as posed pesticides residue problem in cumin. To overcome pesticides residue problem, fungicides having less residue effect is very essential. Hence, spraying of fungicides was tested under field conditions to find out their efficacy against blight and powdery mildew as well as low fungicidal load.

MATERIALS AND METHODS

A field experiment was conducted during rabi 2014-15 and rabi 2015-16 to evaluate the bio–efficacy of tebuconazole 25 WG against Alternaria blight (*Alternaria burnsii*) and powdery mildew (*Erysiphe polygoni*) diseases of cumin. The trial was laid out in a randomized block design (RBD) with eight treatments (Table 1). The size of each plot measured 4.0 × 3.0 m^2. Gujarat Cumin 4 was sown keeping spacing at 30 cm. All the recommended agronomic practices were adopted as per package of practices except fungicidal sprays. The fungicidal application was done at initiation of disease in the crop. Total two sprays were applied at 20 days interval. Observations were recorded from ten randomly selected plants as per the disease scale (0-4 scale) (Rathore and Rathore, 1995) and from that percent disease intensity (PDI) was calculated as under, analyzed and given in tabular form.

Alternaria blight		Powdery mildew	
0	0-1% (No disease),	0	No Symptoms
1	1-6% (Slight),	1	1 - 10%
2	6-9% (Moderate),	2	11-25%,
3	10-49% (severe)	3	25 - 50%,
4	>49% (Very severe)	4	>51% inflorescence coverage by powdery mildew.

The data recorded on yield parameter after harvesting of the crop. The individual plant was kept for sun drying for a day and yield was recorded plot wise and later extrapolated to per hectare basis and statistically analyzed.

Table 1 Treatment details of the trial with test chemicals and the dosage

Sr. No.	Treatment	Dose of formulation (g or ml/ha)
1	Tebuconazole 25WG #	500
2	Tebuconazole 25WG #	750
3	Tebuconazole 25WG #	1000
4	Tebuconazole 25WG *	1500
5	Tebuconazole 25WG *	3000
6	Difenoconazole 25EC	50 ml / 100 L water
7	Mancozeb 75WP	330 g / 100 L water
8	Untreated control	

T_1, T_2, T_3, T_6, T_7 and T_8 for bio-efficacy study

*T_4 and T_5 for Phytotoxicity study.

Phytotoxicity symptoms were recorded using scale (0-10) at 1, 3, 7 and 10 days after each spray. Ten plants were selected at random from each plot and the total number of leaves and those showing phytotoxicity symptoms such as leaf tip and surface injury, wilting, vein clearing, necrosis, epinasty and hyponasty were rated and converted into percentage and given in tabular form.

Table 2 Scores used for effect on crop health

Score	Percent crop affected	Score	Percent crop affected
0	No adverse effect	6	51-60
1	1-10	7	61-70
2	11-20	8	71-80
3	21-30	9	81-90
4	31-40	10	91-100
5	41-50		

RESULTS AND DISCUSSION

Percent disease intensity of blight:

It revealed from the data presented in Table-3 that all the treatments of tebuconazole 25 WG were found significantly superior over untreated control. The lowest percent disease intensity (PDI) of Alternaria blight was recorded in the treatment of tebuconazole 25 WG @ 750 g /ha i.e 13.22, 16.58, 20.82 and 23.81 per-cent at 10 and 20 days after 1st and 2nd spray respectively during 2014-15.While during the year 2015-16, all the treatments of tebuconazole 25 WG were found significantly superior over untreated control. The lowest percent disease intensity (PDI) of Alternaria blight was recorded in the treatment of tebuconazole 25 WG @ 750 g /ha i.e 13.08, 16.88, 21.60 and 22.95 percent at 10 and 20 days after 1st and 2nd spray respectively. Mancozeb 75 WP @ 1650 g/ha also recorded significantly the low Alternaria blight intensity (Table 4). The results obtained in the present study can be corroborated with the findings of earlier workers (Dange, 1995; Akbari *et al.*, 1996; Sharma *et al.*, 2013 and Patel *et al.*, 2017).

Per cent disease intensity of powdery mildew:

The data presented in Table-3 revealed that all the doses of tebuconazole 25 WG were found significantly superior over control against powdery mildew of cumin. The percent disease intensity was recorded in tebuconazole 25 WG @ 750 g/ha i.e. 15.42, 19.79, 21.28 and 23.26 percent at 10 and 20 days after 1st and 2nd spray, respectively. Difenaconazole 25 EC @ 250 ml/ha also significantly reduced powdery mildew intensity over control plot during 2014-15. While during the year 2015-16 also, all the doses of tebuconazole 25 WG were found significantly superior over control against powdery mildew of cumin. The percent disease intensity was recorded in tebuconazole 25 WG @ 750 g/ha i.e. 16.11, 21.53, 22.97 and 24.60 per cent at 10 and 20 days after 1st and 2nd spray, respectively. Difenaconazole 25 EC @ 250 ml/ha also recorded significantly the lowest powdery mildew intensity (Table 4). Similar results were also recorded earlier by Nandha Kumar *et al.*, (2012) and Patel *et al.*, (2013).

Phytotoxicity of Caviet 25 WG on cumin crop:

Phytotoxicity symptoms such as chlorosis, necrosis, wilting, scorching, epinasty and hyponasty (Table 6.1 to 6.6) were recorded on cumin crop sprayed with tebuconazole 25 WG @ 1500 g /ha during 2014-15 and 2015-16. From the present study it can be concluded that, tebuconazole 25 WG @ 1500 g /ha does not exhibit any phytotoxicity symptoms in cumin crop.

Cumin seed yield:

Yield parameter was also recorded as per the procedure mentioned in the methodology, separately for both the years from each plot, converted into ha basis, analysed and presented in Table-5. Application of tebuconazole 25 WG @ 750 g/ha significantly increased cumin yield (274.0 kg/ha and 541.0 kg/ha, in 2014-15 and 2015-16, respectively) in both the years over untreated control (184.0 kg/ha and 251.0 kg/ha, in 2014-15 and 2015-16, respectively).

CONCLUSION

On the basis of the two years of investigation it has been concluded that tebuconazole 25 WG @ 750 g/ha was found effective against Alternaria blight (*Alternaria burnsii*) and powdery mildew (*Erysiphe*

polygoni) diseases of cumin with increase in the yield. Higher dose of tebuconazole 25 WG @ 1500 g/ha did not produce any phytotoxic symptoms on cumin crop at different crop stages during sprays. This indicated that tebuconazole 25 WG is non-phytotoxic to cumin crop.

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Table 3 Bio-efficacy of tebuconazole 25 WG against Alternaria blight and powdery mildew diseases of cumin (2014-15)

Treatment	Dose (g/ha)	Per cent disease intensity (PDI)									
		Before spray		10 DA 1st spray		20 DA 1st spray		10 DA 2nd spray		20 DA 2nd spray	
		AB	PM	AB	PM	AB	PM	AB	PM	AB	PM
Tebuconazole 25 WG	500	12.14 (4.42)	12.38 (4.60)	13.59 (5.52)	16.22 (7.80)	16.86 (8.41)	20.55 (12.32)	20.97 (12.80)	22.10 (14.15)	23.93 (16.45)	23.74 (16.21)
Tebuconazole 25 WG	750	11.93 (4.27)	12.34 (4.57)	13.22 (5.23)	15.42 (7.07)	16.58 (8.14)	19.79 (11.47)	20.82 (12.63)	21.28 (13.17)	23.81 (16.30)	23.26 (15.60)
Tebuconazole 25 WG	1000	12.17 (4.45)	11.78 (4.17)	13.25 (5.26)	15.23 (6.90)	16.64 (8.20)	20.44 (12.20)	21.36 (13.27)	22.30 (14.40)	23.87 (16.37)	23.40 (15.77)
Tebuconazole 25 WG	1500	12.15 (4.43)	12.48 (4.67)	13.24 (5.25)	15.89 (7.50)	16.84 (8.39)	21.30 (13.20)	21.72 (13.70)	22.41 (14.53)	24.43 (17.10)	23.68 (16.13)
Tebuconazole 25 WG	3000	12.32 (4.55)	11.54 (4.00)	13.26 (5.26)	15.86 (7.47)	16.86 (8.42)	21.36 (13.27)	21.53 (13.47)	22.25 (14.33)	24.55 (17.27)	23.21 (15.53)
Difenoconazole 25EC	50 ml / 100 L water	12.15 (4.43)	12.57 (4.73)	13.94 (5.80)	16.07 (7.67)	17.22 (8.77)	21.25 (13.13)	21.25 (13.13)	22.30 (14.40)	26.45 (19.83)	23.99 (16.53)
Mancozeb 75WP	330 g / 100 L water	12.05 (4.36)	11.73 (4.13)	13.50 (5.45)	19.00 (10.60)	16.87 (8.42)	26.64 (20.10)	21.16 (13.03)	29.80 (24.70)	25.70 (18.80)	33.50 (30.47)
Untreated control	--	12.59 (4.75)	12.57 (4.73)	21.33 (13.23)	22.06 (14.10)	24.20 (16.80)	29.85 (24.77)	28.50 (22.77)	36.27 (24.70)	36.29 (35.03)	41.48 (43.87)
S.Em. +		0.27	0.48	0.57	0.53	0.36	0.94	0.53	0.75	0.50	0.92
C.V. at 5%		NS	NS	1.70	1.60	1.10	2.80	1.60	2.30	1.70	2.80

DA: Days After, AB: Alternaria Blight, PM: Powdery mildew

Figures in parenthesis are re-transformed values of Arc cine transformation

Table 4 Bio-efficacy of tebuconazole 25 WG against Alternaria blight and powdery mildew diseases of cumin (2015-16)

Treatment	Dose (g/ha)	Per cent disease intensity (PDI)									
		Before spray		10 DA 1st spray		20 DA 1st spray		10 DA 2nd spray		20 DA 2nd spray	
		AB	PM	AB	PM	AB	PM	AB	PM	AB	PM
Tebuconazole 25 WG	500	10.61 (3.39)	12.25 (4.50)	13.55 (5.49)	16.78 (8.33)	16.89 (8.44)	21.51 (13.45)	20.76 (12.56)	23.22 (15.55)	23.30 (15.65)	25.29 (18.25)
Tebuconazole 25 WG	750	10.48 (3.31)	12.25 (4.50)	13.08 (5.12)	16.11 (7.70)	16.88 (8.43)	21.53 (13.47)	21.60 (13.56)	22.97 (15.23)	22.95 (15.65)	24.60 (17.33)
Tebuconazole 25 WG	1000	10.72 (3.46)	12.11 (4.40)	13.16 (5.18)	15.68 (7.30)	17.02 (8.56)	21.30 (13.20)	21.77 (13.76)	23.08 (15.37)	23.08 (15.37)	24.97 (17.82)
Tebuconazole 25 WG	1500	10.68 (3.44)	12.20 (4.47)	13.17 (5.19)	16.22 (7.80)	17.00 (8.54)	21.16 (13.03)	21.83 (13.83)	23.18 (15.50)	23.03 (15.30)	24.80 (17.60)
Tebuconazole 25 WG	3000	10.82 (3.53)	12.25 (4.50)	13.25 (5.19)	16.07 (7.67)	16.88 (8.43)	21.42 (13.33)	21.92 (13.93)	23.08 (15.37)	23.18 (15.50)	24.80 (17.60)
Difenoconazole 25EC	50 ml / 100 L water	10.68 (3.44)	12.11 (4.40)	13.45 (5.41)	15.64 (7.27)	17.22 (8.77)	20.39 (12.13)	22.75 (14.96)	22.81 (15.03)	25.96 (19.17)	23.85 (16.35)
Mancozeb 75WP	330 g / 100 L water	10.61 (3.44)	12.20 (4.47)	13.48 (5.43)	19.25 (10.87)	17.67 (9.21)	27.25 (20.97)	20.80 (12.61)	30.72 (26.10)	22.08 (14.13)	35.35 (33.47)
Untreated control	--	10.72 (3.46)	12.29 (4.53)	20.70 (13.55)	22.30 (14.40)	23.22 (15.54)	30.37 (25.57)	28.01 (22.06)	36.67 (35.67)	33.23 (30.03)	40.18 (41.63)
S.Em. ±		0.30	0.40	0.54	0.51	0.26	0.83	0.41	0.77	0.47	0.84
C.D. at 5%		NS	NS	1.60	1.60	0.80	2.50	1.20	2.30	1.40	2.50

DA: Days After, AB: Alternaria Blight, PM: Powdery mildew

Figures in parenthesis are re-transformed values of Arc cine transformation

Table 5 Seed yield (kg/ha) of cumin in different treatments (2014-15 and 2015-16)

Treatment	Dose (g/ha)	Cumin seed yield (kg/ha)	
		2014-15	2015-16
Tebuconazole 25 WG	500	268	533
Tebuconazole 25 WG	750	274	541
Tebuconazole 25 WG	1000	272	542
Tebuconazole 25 WG	1500	274	531
Tebuconazole 25 WG	3000	272	534
Difenoconazole 25EC	50 ml / 100 L water	274	542
Mancozeb 75WP	330 g / 100 L water	267	531
Untreated control		184	251
S.Em. +		11.45	13.45
C.D. at 5%		34.70	40.80

Evaluation of phytotoxicity of tebuconazole 25 WG on cumin (2014-15 and 2015-16):

Table 6.1 Evaluation of phytotoxicity of tebuconazole 25 WG on chlorosis

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

Table 6.2 Evaluation of phytotoxicity of tebuconazole 25 WG on necrosis

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

Table 6.3 Evaluation of phytotoxicity of tebuconazole 25 WG on wilting

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

Table 6.4 Evaluation of phytotoxicity of tebuconazole 25 WG on scorching

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

Table 6.5 Evaluation of phytotoxicity of tebuconazole 25 WG on hyponasty

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

Table 6.6 Evaluation of phytotoxicity of tebuconazole 25 WG on epinasty

No.	Treatment	Dose g /ha	Days after 1st spray					Days after 2nd spray				
			1	3	5	7	10	1	3	5	7	10
1	Tebuconazole 25 WG	750	0	0	0	0	0	0	0	0	0	0
2	Tebuconazole 25 WG	1500	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	0	0	0	0	0	0	0	0	0	0

REFERENCES

Akbari, L.F., I. U. Dhruj, R. R. Khandar and Vaishnav, M.U. 1996. Management of cumin blight through fungicides. *Pl. Dis. Res.* **11**: 103-105.

Anonymous, 2017. Horticultural Statistics at a Glance GOI, Deptt.of Agril., Horticulture Statistics Division.

Champawat, R.S. and V. Singh. 2008. Seed Spices. In Disease Management in Arid Land Crops. Eds. Lodha,S., Mawar, R and Rathore, B. S. Scientific Publishers (India) Jodhpur, p.197- 232.

Dange, S.R.S., 1995. Diseases of cumin (*Cuminum cyminum* L.) and their management. *J. Spices and Aromatic Crops.* **4**: 57-60.

Dange, S.R.S, Patel, R.R., Patel, S.S. and Patel, K. K. 2012. Management of cumin blight by different spray schedules of mancozeb. *Agric. Sci .Digest.* **22** (2):99-102.

Gemawat, P. D. and N. Prasad, 1972. Epidemiological studies on Alternaria blight of *Cuminum cymanium* L. *Ind. J. Mycol. Pl. Pathol.* **2**: 65-74.

Nandha kumar N. and V. Ponnuswami, 2012. Studies on the bio efficacy of Tebuconazole 25 WG against downy mildew and powdery mildew of grape cv. Muscat Hamburg, Paper presented in International Conference on Agricultural & Horticultural Sciences held at International Convention Centre, Hyderabad, India on September 14-15, 2012

Patel, N. R. 2011. Study on powdery mildew of Cumin (*Cuminum cyminum* L.) caused by Erysiphe polygoni DC. and its management. Ph.D. (Agri.) Thesis in Plant Pathology S. D. Agricultural University, Sardarkrushinagar, Gujarat.

Patel, N. R, Amin, A. M. and Amin, A. U. 2017. Chemical management of cumin blight. *International J. Seed Spices.* **7** (2): 68-72.

Rathore , B.S and Rathore, R.S 1995. Studies on varietal resistance and chemical control of powdery mildew of fenugreek (*Trigonella foenum-graecum* L.). *Ind. J. Mycol. and Pl. Pathol.* **25** (3):260-262

Sharma Y. K., K. Kant, R. K. Solanki and R. P. Saxena, 2013. Prevalence of cumin diseases on farmer's field: A survey of Rajasthan and Gujarat states. *International J. Seed Spices.* (3):46-49.

Sharma Y.K., M. M. Anwer, S. N. Saxena and K. Kant, 2010. Getting disease free seed spices. *Ind. Hortil.* **55**: 22-24.

Sharma Y. K , P.C. Choudappa and M.M. Anwer, 2013. Efficacy of fungicides for the management of Alternaria blight of cumin. *International J. Seed Spices.* **3** (1):48-49.

Solanki, J.S., R.R. Singh and G.G. Delela, (1973). Field evaluation of fungicides in controlling Alternaria blight of Cuminum cyminum. *Ind. J. Mycol. and Pl. Pathol.* **3**: 191- 197.

Uppal, B. N., Patel, M.K. and Kamat, M.N. 1938. Alternaria blight of cumin. *Indian J. Agric. Sci.* **8**: 49-62.

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