Studies on Hybrid Maize (*Zea Mays*)

1. EFFECT OF SPACING AND FERTILITY LEVELS ON YIELD OF DECCAN HYBRID MAKKA

K. P. M. NAIR, A. G, G. MENON, AND C. M. GEORGE *

Division of Agronomy, Agricultural College & Research Institute, Vellayani

Received for publication December 30, 1965

Maize is one of the important crops which meet the dietary needs of man and also which provide raw materials for a wide variety of industrial products. At present the extensive cultivation of maize in India is chiefly confined to parts north of the Deccan Plateau.

A Co-ordinated Maize Improvement Scheme was started at the I. A. R. I., New Delhi, in collaboration with the Rockefeller Foundation and also with different State Departments of Agriculture. So far nine hybrid varieties, viz., Ganga 1 Ganga 3, Ganga 101, Ganga Safed 2, Deccan, Ranjit, VL 54, Him 23 and Hi-Starch, have been evolved and released.

In order to find out the possibilities of raising maize as a subsidiary food crop in Kerala, a preliminary trial was conducted in the Agricultural College & Research Institute Farm, Vellayani, with Deccan Hybrid Makka and encouraging results were obtained. Hence a detailed investigation was conducted during the *Kharif* season, 1963, with the following objectives:

1. To arrive at a suitable manurial schedule for the maize crop under Kerala conditions, and

2. To find out a proper spacing for the crop under Kerala conditions.

Review of Literature

Extensive investigations on fertilization of maize have been carried out both in India and elsewhere in the world. Vaidyanathan (1933) reported high response of maize to nitrogenous fertilizer application in Bihar. Application of sulphate of ammonia at the rate of 100 kg per hectare at the time of planting considerably increased the yield of marketable grains in the dry season culture(Calma and Castro, 1950). Dhesi (1953) recommended an economic dose of 1¼ mds of sulphate of ammonia per acre (115.95 kg/ha) for richer soils and 4 mds of sulphate of ammonia per acre (368.99 kg/ha) for lighter soils to give good maize yields. Long (1953) stated that for an yield of 100 bushels per acre the crop needed about 150 lb of N (168.15 kg/ha), 58 lb of P_2O_5 (65.00 kg/ha) and 110 lb of K_2O (123.30 kg/ha) per acre. Nandpuri (1960) concluded that high yields of grain can be obtained with 180 lb per acre (201,78 kg/ha) for a plant population of 26000 plants per acre (64,220/ha). Verma and Bhatnagar (1962) in a fertilizer-spacing-variety studies,

Research Officer, Junior Professor and **Professor** respectively.

observed that at 3 levels of nitrogen (44.84, 89.68 and 134.52 kg/ha) and 4 spacings, higher yields were obtained from 134.52 kg/ha. Shah and Gautam (1964) reported that maize yielded highest when fertilized with 179 kg of N/ha, but the increase in yield after 90 kg/ha was not statistically significant. Investigations carried out by Shah and Gautam (1964) showed that Ganga 101 recorded increasingly higher yields upto 180 kg/ha.

Sen and Kavitkar (1956) from the Pusa Permanent Manurial Experiments reported highly significant response to nitrogen but not to phosphorus. Hinkle and Garrett (1961) found that P and K were of limited or even negligible value in increasing the yield of maize.

Nezamuddin and Prasad (1958) recommended 2 ft row spacing for N, Bihar and 1.5 ft row spacing for S. Bihar and the hilly tracts of Chotanagpur. The best spacing between plants was 12 inches (30.5 cm). Highest yields of maize, with the heaviest dose of mineral nitrogen at the closest spacing of 2 ft (61 cm.) was recommended by Verma and Sharma (1958). Fielding (1958) observed that increased yields could be obtained by increasing the plant population to a maximum of 14520 per acre (35865 per hectare). Nandpuri (1960) reported highest yield of maize grain with approximately 26000 plants per acre (64220 per hectare) and 180 lb of N per acre (201.78 kg per hectare). Nine years corn fertilizer and spacing experiment by Hinkle and Garrett (1961) proved that the optimum plant population when nutrient supply was adequate, was between 12000 and 16000 plants per acre (29640 per hectare and 39520 per hectare respectively). Relwani (1962) reported that closer spacing of 24 inches (61 cm) and 9 inches (23 cm) produced higher yield of maize than 24" x 12" (61 cm x 30.5 cm) and 30" X 12" (71 cm x 30.5cm). Gautam *et al* (1964) concluded that a wider row spacing of 91 cm and 25 cm between plants may be adopted without adversely affecting the yield of maize.

Materials and Methods

The experiment was laid out at the Agricultural College and Research Institute Farm, Vellayani during the Kharif season of 1963. The soil of the experimental site was red loam having a low N content (0.05%), low available P (0.0021%) and low potash (0,077%). The total rainfall averaged 620 mm during the crop period from 1—7—1963 to 30—10—1963. The maximum and minimum temperatures during 1963 were 31.660 and 27.770° C respectively The maximum relative humidity which prevailed during the crop season in 1963 was 88.7 per cent.

A seed rate of 15.0 kg per hectare of ths variety Deccan Hybrid Makka was used for the trial. The percentage of germination was 98. A basal dose of well decomposed F. Y. M. was given at the rate of 3750 kg per hectare. Nitrogen, Phosphorus and Potash were supplied in the form of Sulphate of Ammonia, Superphosphate and Muriate of Potash respectively.

The whole of F. Y. M. (3750 kg per hectare), Superphosphate(74.10 kg per hectare) and Muriate of Potash (37.0 kg per hectare) and rd of Ammonium sulphate were given as basal dressing and the balance 2/3rd of Ammonium sulphate was top dressed at tasseling stage (50 days after sowing).

The experiment was laid out in Randomised Block Design with 4 replications with plots having a size of 5.5 m x 6.1 m with the following treatments :

Spacings

S_1 : 61 cm.

S_2 '• 76 cm.

S_3 : 91 cm.

N, Levels

N_1 : 74.10 kg per hectare

N, : 111.15

N_3 : 148.20

The crop was sown on 4-7-1963 and was harvested on 30-10-1963.

Results and Discussion

1. Height ofplants

TABLE I

Maximum height of plants due to different treatments

Treatment	Height in cm, 70 days after sowing
8,	160.68
S_2	167 22
S_3	146.48
N^I	154.86
N_2	157.28
N_3	162.29
t test	Sig
S. Em,	6.69
C. D. at 5%	[1.25

It is seen from Table I that among all the treatments spacing alone significantly affected the height of plants. This increase in height of plants in narrow spacings of S_1 and S- may be due to insufficient insolation resulted by higher plant population.

2. Earliness in cobbing

TABLE II

Average number for cobbing due to different treatments

Treatment	Msan number of days
S_1	65
S_2	64
S*	67
N_1	67
N«	66
N_3	65
t test	Not significant
S. Em	1.51

It is seen from Table II that neither spacings nor N levels had any significant effect in bringing the plants to early cobbing. But, between spacing treatments, plants in S. treatments took minimum number of days (64) while between N levels N_3 had taken the minimum of 65 days. The results indicate that earliness in cobbing was not significantly influenced by the various treatments tried.

3. Cob studies

TABLE III

Mean length, girth and weight of cob as affected by various treatments

Treatment	Mean length (cm)	Mean girth (cm)	Mean weight (g)
S.	14.65	3.91	158.88
S_2	15.78	4.04	184.09
S_3	15.77	3.95	174.08
N_1	14.64	3.86	154.38
N_2	15.84	3.98	178,84
N_3	15.74	4.06	183.93
t test	N. S.	N. S.	N. S.
S. Em.	0.73	0.087	13.53

None of the cob characters studied was affected significantly by the treatments. S_2 spacing followed by S_3 and S_1 showed comparatively higher values for all the characters studied. Similarly there was corresponding increase in the girth and weight of cob with increases in nitrogen levels. Long *et al* (1956) and Nandpuri (1960) found that the cob weight significantly increased as the nitrogen dose was increased.

4. Yield studies

TABLE IV

Mean grain yield per plant and per plot and the mean stover yield per plot as affected by various treatments

Treatment	Mean grain yield/plant (g)	Mean grain yield/plot (kg)	Mean stover yield/plot (kg)
S_1	126.6	11.02	10.54
S_2	146.5	1018	10.49
S_3	135.9	6.21	7.76
N_1	112.9	8.49	7.74
N_2	137.5	9.53	9.39
N,	158.5	10.39	11.66
t test	Sig.	Sig.	Sig.
S. Em.	9.63	0.82	0.86
C. D. at 5%	16.21	1.37	1.38
	N_3 N_2 N_1	N_3 N_2 N_1	N_3 N_2 N_1
		S_1 S_2 S_3	S_1 S_2 S_3

It is seen from Table III that all the levels of nitrogen tried significantly increased the yield of grain both per plant and per plot and also the stover yield. As for the grain yield per plant and for stover yield per plot N_3 was superior to N_2 and N_3 and N_2 were superior to N_1 application. There was no significant increase in grain yield per plot between N_3 and N_2 applications and between N_2 and N_1 applications. But N_3 application was superior to N_1 application. These results confirm the findings of earlier workers like Calma and Castro (1950), Dhesi (1953), Verma and Sharma (1958), Nandpuri :(1960), Hinkle and Garrett (1961), Relwani (1962} and Shah and Gautam (1964).

The spacing treatments significantly increased the per plot yield of grain and stover. In both cases S_1 and S_2 treatments gave a significantly higher yield than S_3. But there was no significant differences in yield between S_1 and S_2. This is in close conformity with the findings of Verma and Sharma (1958), Nandpuri (1960) and Relwani (1962).

5. *Test weight of grain*

TABLE V

Mean test weight of 1000 grain as affected by various treatments

Treatment	Mean test weight of 1000 grain (g)
S_1	274.91
S_2	294.81
S_3	273.69
N_1	275.55
N_2	276.75
N_3	281.95
t test	N. S.
S. Era.	9.83

Table V shows that both spacings and nitrogen levels had no significant effect on the test weight of grains. However there is a trend showing that as nitrogen level is increased the test weight is also increased. This may be because the variations between levels of nitrogen was not sufficient to show a significant difference. Sharma (1961) also found that nitrogen application to maize increased the test weight of grains.

Summary and Conclusions

1. Of the three spacings tried (61 cm, 76 cm and 91 cm) 76 cm between rows and 30,5 cm between plants increased the weight significantly.

2. There was a significant increase in yield per plant from 112.9 g to 158.5 g as the nitrogen level increased from 74.10 kg/ha to 148.20 kg/ha.

3. Application of 148,20 kg/ha increased the yield of grain by 22.4% over 74.10kg of N/ha. The dose of 148,20 kg of N/ha gave an average grain yield of 4436.08 kg/ha.

4. The application of 148.20 kg of N/ha increased the yield of stover by 50.64% and 21.31% over 74.10 kg of N/ha and 111.15 kg of N/ha respectively.

5. The narrow spacing of 6] cm between rows gave significantly higher yield of grain and stover over 91 cm spacing but the increase over 76 cm spacing was not significant.

The results of this investigation indicate that maize can successfully be grown under Kerala conditions and that economic yields can be obtained by planting at a spacing of 61 cm between rows and 30.5 cm between plants and by giving nitrogen at 148.20 kg per hectare over a basal dose of 3750 kg of farm yard manure, 74.10 kg of phosphorus and 37.00 kg of potash per hectare, during the fc/wi/season. Since there is an increasing trend in yield corresponding to increased levels of nitrogen the optimum level may be even beyond 148.20 kg/ha. This requires further investigation.

Acknowledgement

The authors are grateful to Dr. C. K. N. Nair, Principal & Additional Director of Agriculture(Research),AgriculturalCollege and Research Institute, Vellayani, for the encouragement and guidance given by him in carrying out this investigation. They take this opportunity to thank Shri. E. J. Thomas, Junior Professor of Statistics for the help rendered in the statistical layout and analysis of data.

References

1. Calma, V. C. and Castro, D. C (1950) The effect of the time of applying ammonium sulphate in the yield of corn *Philipp. Agricst.* 34 : 116-120.

2. Dhesi, Ajit Singh (1953) Application of Sulphate of ammonia to the maize crop. *Punjab Farmer. 5* (4) : 3940.

3. Fielding, W. L. (1959) The effect of plant population, N, P and K on Maize. *Rep. Fed Minist. Agric, Rhod. and Nayasaland.* 1958-'59 : 86.

4. Gautam, 0. P., Shah, V. H. and Nair, K. P. M. (1961) Agronomic Investigations with Maize. II Study of inter cropping, row spacing and method of phosphorus application with Hybrid maize. *Ind. J. Agro.* IX (4) : 247-254.

5. Hinkle, D A, and Garrett, J. D. (1961) Corn fertilizer Spacing expts. *Arkansas Corn Production Agric. Expt, Sta. Bull.* 635 : 34.

6. Long, 0. H. (1953) Nitrogen and plant population in corn production. *Tenn. Agric. Expt. Sta. Bull.* 232 : 34.

7. Nandpuri, K. S. (1960) Studies on the effect of different plant populations and N levels on the yield and protien content of maize grain. *Ind. J. Agro. 4* (3) : 171-175.

8. Nazamuddin, S. and Prasad, L. K. (1958) Spacing experiment on maize. yield in Bihar. *Allahabad Far.* 321. (5): 159-67.

9. Relwani, L. L. (1962) Studies on the effects of spacing, dates of sowing and fertilization on the yield of maize. *Ind. J. Agro. 6* (3) : 169-77.

10. Shah, V. H. and Gautam, C. P. (1964) Nitrogen fertilization for maize. *Agrl. Res. 4* : (2)

11. Sen, S, and Kavitkar, A. G. (1956) Statistical studies of the crop yield data of Pusa permanent manurial Expts. 1. Study of maize yield. *Ind, J. Agri. Sci*. 26 (1) : 105-30.

12. Vaidyanathan (1933) Summary of fertilizer Expt. in India, *Vol. L. II*. and ///, /. *C. A. R,* New-Delhi.

13. Verma, G. and Bhatnagar, P. S. (1962) Fertilizer-Spacing-Variety studies on *Zea Mays* in U. P., *Ind. J. Agri. Sci.* 32:1-8

14. Verma, R. D. and Sharma, J. C. (1958) Effect of different doses of N and P placed and broadcast and of row spacings in maize. *Ind. J. Agri, Sci,* 28 : 11-20.