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PLANT DENSITY AND NUTRIENT MANAGEMENT FOR RAINFED MAIZE IN RED SOILS

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ABSTRACT

Experiments indicated that grain yields of 2 t ha^{-1} could be obtained from maize grown during Kharif season under rainfed conditions in the red soils of north-western zone. Varieties Co H 1 and K 1 yielded 2037 and 2060 kg grain ha^{-1}. Plant density of 1,11,000 plants ha^{-1} with a spacing of 45 x 20 cm was found optimum for high yields. An integrated nutrient management system involving the application of azospirillum through seed and soil recorded an yield of 1119 kg ha^{-1} under moisture stress conditions and 2296 kg^{-1} during normal rainfall year. Seed and soil inoculation of azospirillum increased the length and dry weight of roots of rainfed maize.

Under dryland conditions, maize provides a good opportunity for increasing the food production and income from small and marginal farms. Trials conducted in AICRPDA indicated the potential for high yields of rainfed maize. It has already become a popular crop in the semiarid red soils of Bangalore region (Sanghi, 1985). In the North Western Zone of Tamil Nadu, rainfed farming is predominant in red soils. The area under maize here is only 1700 ha. With the development of new technology, dryland maize can become a promising crop in such non-traditional environments also. The components of such a technology package include suitable varieties, optimum plant density and fertilizer manangment practices.

MATERIALS AND METHODS

Field experiments were conducted at Tamil Nadu Agricultural University, Regional Research Station, Paiyur, during 1988-90 to evaluate the potential of maize varieties under rainfed conditions and to evolve cultural practices for getting higher yield from rainfed maize. The soill of the experimental field was red sandy loam, low in available N, medium in P and high in K content. The rainfall received during the cropping season from July to October was 342 and 386 mm in 15 and 21 days, respectively, during the two years of study.

During 1988-89, the experiment was laid out in split plot design, replicated thrice. The main plot

Table 1. Grain yield of maize varieties under two plant densities.

Density ha^{-1} variety	Grain yield Kg ha^{-1}					
	88-89			89-90		
	1,11,000	83,000	Mean	1,11,000	83,000	Mean
UMH 9	556	509	532	1697	1420	1555
Co H 1	496	409	453	2145	1929	2037
K 1	530	517	523	2145	1975	1792
Co 1	-	-	-	1914	1667	2060
Ganga 5	630	772	772	-	-	-
Mean	553	552		1977	1745	
	CD			CD		
Variety	130			136		
Density	NS			96		

Table 2. Grain yield of rainfed maize with nutrient management.

Fertilizer NPK kg ha^{-1}	Grain yield Kg ha^{-1}					
	88-89			89-90		
	No Azo	With Azo	Mean	No Azo	With Azo	Mean
Control	91	139	115	-	-	-
FYM Only	-	-	-	954	1018	986
40:20:0	475	602	538	1593	2055	1824
60:30:30	889	1119	1004	2102	2296	2199
90:45:45	-	-	-	1537	2120	1828
Mean	485	620	-	1546	1872	

consisted of four maize varieties in two plant densities. In the sub-plots, three levels of fertilizers with and without azospirillum were compared. In 1989-90, two trials were condcted. Four varieties under two plant densities were evaluated in one experiment. In the other experiment, four nutrient levels were compared with and without azospirillum inoculation. These two trials were laid out in factorial RBD replicated thrice. The crop was sown in August 88 and July 89 in the two years, respectively. Maize seeds were dibbled on the sides of ridges. Azospirillum at 0.5 kg ha^{-1} was used for seed inoculation and 2 kg ha^{-1} for soil application at sowing. Phosphorus, Potash and 50% N were applied basally at sowing. Remaining N was top dressed in two equal splits at knee high and tasselling stage. Observations on growth characters, yield attributes and yield of grain and straw were recorded.

RESULTS AND DISCUSSION

Yield potential of maize varieties : The yield level of all the maize varieties was low during 1988-89 (Table - 1) due to mositure stress during

Table 3. Growth characters and yield attributes of rainfed maize.

Treatment	Height (cm)		Cob length (cm)		Cob weight (g)		Grains/cob	Grain weight/cob		Straw yield kg ha^{-1}	
	88-89	89-90	88-89	89-90	88-89	89-90	89-90	88-89	89-90	88-89	89-90
UMH 9	126	166	8.6	11.8	37.5	43.0	216	26.9	33.2	3097	2855
Co H 1	120	150	8.6	11.2	29.4	41.8	219	22.3	35.2	2467	2160
K 1	122	169	8.6	11.2	39.4	40.5	200	30.3	37.0	2704	2237
Co 1	-	179	-	13.0	-	47.5	228	-	35.0	-	3626
Ganga 5	128	-	9.8	-	46.8	-	-	36.6	-	3250	-
CD	NS	15	0.8	NS	11.6	NS	NS	5.4	2.7	257	507
Density ha^{-1}											
1,11,000	123	168	8.6	11.3	33.8	39.6	191	25.5	33.3	3085	3009
83,000	124	164	9.1	12.3	42.8	46.8	241	32.5	36.8	2674	2430
CD	NS	NS	NS	NS	8.0	6.4	22	3.8	1.9	287	359
Fertillizer											
Control	100	-	6.8	-	18.9	-	-	14.7	-	1838	-
FYM	-	140	-	11.4	-	45.5	214	-	34.7	-	2701
40:20:0	132	166	-	12.3	44.5	50.7	248	33.5	40.5	3180	3472
60:30:30	139	165	9.9	13.1	50.7	58.2	256	38.9	47.3	3625	3858
90:45:45	-	182	-	12.2	-	48.5	223	-	42.5	-	3804
CD	5.2	11	0.6	0.5	6.6	9.1	.21	5.4	4.5	160	392
Biofertilizer											
No inoculation	118	162	8.9	12.1	37.0	47.1	217	26.1	37.1	2741	3279
Inoculated	130	169	8.9	12.4	39.6	54.3	245	32.0	45.4	3021	3638
CD	4.2	NS	NS	NS	NS	6.4	15	4.4	3.2	130	278

Table 4. Root characters of rainfed maize with nutrient management.

Fertilizer NPK kg ha^{-1}	Root Length (cm)			Root weight / plant (g)		
	No Azo.	With Azo.	Mean	No Azo.	With Azo.	Mean
FYM	19.1	21.12	20.1	5.9	9.8	7.9
40:20:0	19.2	22.6	20.9	5.9	11.0	8.5
60:30:30	20.4	23.5	21.9	6.9	10.1	8.5
90:45:45	20.5	24.2	22.3	7.1	11.1	9.1
Mean	19.8	22.8		6.4	10.5	

the critical phases of post-tasselling and silking stages. Among the four varieties, Ganga 5 produced higher grain yield of 701 ka ha^{-1}. Higher grain yeild of Ganga 5 was associated with longer cobs, greater cob weight and grain weight per cob (Table - 3). Favourable distribution of rainfall during 1989-90 resulted in high grain yields. Varieties K1 (2060 kg ha^{-1}) and Co H 1 (2037 kg ha^{-1}) yielded more than UMH 9 and Co 1. High grian yield of variety K 1 was due to higher grain weight per cob (Table 3). Straw yield was higher with Ganga 5 during first year and with Co 1 in the second year. This was possibly due to the taller nature of the two varieties (Table 3).

Effect of plant density : Two plant densities viz. 1,11,000 plants (45 x 20 cm) and 83000 plants (60 x 20 cm) per ha were compared. While there was little difference in grain yield between the two densities in the first year, the greater density of 1,11,000 plants ha^{-1} recorded higher grain yield (1977 kg ha^{-1}) over the lower density (1745 kg ha^{-1}) during the second year of study (Table 1). Though the development of individual cobs in terms of length, grains per cob, cob weight and grain weight per cob was better with wider spacing (60 x 20 cm), the reduction in plant density resulted in lesser cobs per unit area and lower grain yield (Table 3). Sanghi (1985) reported that the crop geometry of 45 x 20 cm was found optimum for rainfed maize in most areas. Straw yield was more with higher plant density, obviously due to the increased number of stalks per unit area.

Effect of fertilizer levels : Inspite of moisture stress at critical stages during the first year, the use of fertilizers increased the grain yield considerably. Application of 60:30:30 kg NPK ha^{-1} increased the grain yield by 889 kg ha^{-1} over no fertilizer. During 1989-90 also, the fertilizer level of 60:30:30 kg NPK ha^{-1} produced the highest grain yield of 2199 kg ha^{-1} (Table .2). All the yield parameters viz. cob length, grains per cob, cob weight, grain weight per cob and test weigth of grains, were improved by fertilizer application, leading to higher grain yield (Table 3). The results are only added evidence to the usefulness of fertilizer application to rainfed maize (Ranjodh Singh, 1983). In the rainfed red soils of Bangalore, balanced use of NPK resulted in high grain yields from rainfed maize (Sanghi, 1985). In AICRPAD trials, rainfed maize responded upto 30 kg P_2O_5 ha^{-1} (Singh, 1986). Significant increase in plant height due to fertilizer use resulted in higher straw yields.

Effect of Azospirillum inoculation : Ino culation of Azospirillum through seed and soil increased the grain yield of rainfed maize by 22 and 21 per cent, respectively, in the two years of study (Table 2). Higher grain yield with azospirillum inoculation was due to an increase in grain per cob and grain weight per cob (Table 3). In rainfed sorghum and pearl millet, seed inoculation with azospirillum increased the yield by 8 - 23 per cent. Promotion of root growth through azospirillum inoculation was evident from the improvement in root length and root dry weight in the inoculated plots (Table 4). This would have enabled the crop to make better use of available moisture and nutrients under azospirillum inoculated conditions. Highest grain yields in both the years were obtained with 60:30:30 kg NPK ha^{-1} and azospirillum inoculation.

The results of this investigation established the potential of rainfed maize in the red soils of north western zone of Tamil Nadu. For higher grain yields, the suitable varieties are Co H 1, K 1 and Co 1. The optimum plant density is 1,11,000 plants ha^{-1} with a crop geometry of 45 x 20 cm. An integrated nutrient management system involving the application of 60:30:30 kg NPK ha^{-1} along with azospirillum inoculation through seed and soil would ensure high yields from rainfed maize in red soils.

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CORRELATION STUDIES IN F_2 GENERATION OF RICE (*ORYZA SATIVA* L.) CROSSES

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ABSTRACT

In an investigation with six F_2 generations along with their four parents of rice, it was found that the character ear bearing tillers showed positive and signficant association with grain yield in all the parents and F_2s. Grain number also had significant association with grain yield in all the F_2s and parents except one. Hence, it is suggested that the selection can more confidently be done based on these two characters for the improvement of grain yield in rice.

In rice, the grain yield is a complex character and influenced by other component characters considerably. Hence, a knowledge on the correlation between grain yield and its component characters as well as the inter- correlation between the component characters will be helpful for simultaneous selection for characters influencing the yeild. Therefore, the present study was initiated to study the inter-relationship of six traits in four parents and their six segregating F_2 generations to identify those characters which may be useful as indicators of high yield.

MATERIALS AND METHODS

Four short duration rice varieties, namely, ADT 37. Co 41, IR 50 and ADT 36 along with their six cross combinations, viz., Cross A (ADT 37/Co 41), Cross B (ADT 37/IR 50), Cross C (ADT/37/ADT 36), Cross D (Co 41/IR 50) Cross E (Co 41/ADT 36) and Cross F (IR 50/ADT 36) in F_2 generation were studied in a randomised block design with three replications during June-Septmeber, 1989 at Rice Research Station, Ambasamudram. A total of 90 plants in each of the parents and 360 segregants from each cross were studied. Thirty plants in each parent and 100 F_2 segregants in each cross were randomly selected and data recorded on palnt height, ear bearing tillers, ear length, grain number, 100-grain weight and grain yield. The method suggested by Goulden (1952) was adopted for estimating correlation coefficients for yield and its component traits and among the different component traits.

RESULTS AND DISCUSSION

Phenotypic correlation coefficients between different pairs of characters were estimated separetely in parents and in F_2 generations. The associations between plant height and ear bearing tillers in Co 41, and crosses B, C, E and F, ear length and plant height in ADT 37, and all six crosses, grain number and plant height in ADT 37, Crosses A, D, and E and 100-grain weight and plant height in Crosses A, D and E were positive and significant. Similarly, ear length with ear bearing tillers in Co 41 and crosses C, D, E and F, ear bearing tillers with grain number in Co 41 and crosses A. D and E and 100-grain weight with ear bearing tillers had positive and significant correlation. The association between grain number and ear length in ADT 37 and Co 41 and crosses A, D and E, ear length and 100-grain weight in crosses A, D and E and between grain number and 100-grain weight in crosses D, E and F also exhibited the same trend. But, the associations between grain number and ear bearing tillers in IR 50 and between 100-grain weight and grain number in cross B were negatively significant. This showed