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APPROACHES FOR IMPROVING PRODUCTIVITY OF MAIZE IN THE HILLY AGRO-CLIMATIC REGION OF DARJEELING DISTRICT

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ABSTRACT

Dominance of lower productive, longer duration, fertilizer non-responsive traditional varieties, non -use of chemical fertilizer and preferential choice as secondary crop in maize-winter paddy sequence of as intercrop with highly exhaustive ginger crop are the identified bottleneck of growing maize crop towards higher productivity in hilly region of Darjeeling district. Studies carried out on priority areas particularly in optimum nutrient management through integrated sources, selection of suitable intercropping system and choice of market demanding, shorter duration high yielding maize variety under different altitude situations. Application of 75 % of the recommended fertilizer @ 120:60:60 kg/ha N: P2O5: K2O) together with farm yard manure @ 10t/ha) found to produce higher grain yield and benefit: cost ratio. Green gram in paired row arrangement in between two maize rows shoed profitable intercropping combination in terms of grain yield, benefit cost ratio and LER value. The high yielding composite varieties RCM-1-1, RCM1-2, RCM1-3, JM-8 and JM-12 in the lower and mid hills whereas in the higher hills, the composite variety VL 16 and hybrid HIM 129 were found to produce higher grain yield with farmers acceptance quality as compared to local maize varieties.

INTRODUCTION

Maize in one of the important food grain crops after rice in the Darjeeling hills, covering about 22 thousand hectares of land. It is mainly grown as pre-monsoon crop and is harvested before transplanting winter paddy. However, the area, production and productivity of maize in the Darjeeling hills is declining due to use of local varieties with no application of fertilizer and other improved managements. The local varieties are characteristically lower in productivity even under optimum fertilizer condition and remain in the field for longer period, resulting early harvesting of maize green cob to before transplanting of rice crop. In order to improving the productivity of maize in the Darjeeling district, studies were under taken at the Regional Research Station (Hill Zone), Bidhan Chandra Krishi Viswavidyalaya, Kalimpong through integrated nutrient management system, identification of suitable maize based intercropping system and selection of market-responsive, shorter duration high yielding maize varieties under different altitudes.

MATERIALS AND METHODS

Studies were conducted during the year 1998-2000 at Kalimpong having soils sandy clay loam in texture with pH 5.86, total nitrogen 39.8 gm/kg, available phosphorus 18.1 kg/ha, available potassium 576 kh/ha. The experiment on integrated nutrient management system was laid out in a randomized block design (RBD) and six different treatments (Table 1a) were replicated thrice at random. The second experiment on maize based intercropping system was also laid out in RBD with 7 treatments (Table 2a) and 3 replication. The study on selection of suitable varieties of maize was carried out through Front Line

Demonstration Programme (FLD) using high yielding composite maize varieties RCM-1-1, RCM1-2, RCM1-3, JM-8 and JM 12 in the lower and mid hills (Kalimpong region) and composite variety VL16, hybrid HIM 129 in the higher hills. The participating farmers made suitability assessment.

RESULTS AND DISCUSSION

Approach - 1 : Studies on Intergrated nutrient management system in maize

Effect of nutrient management systems on grain and cob yield

The treatment T3 produced significantly higher grain yield over both T5 and T6 followed by T4 but there was no significant difference between T3 and T4 (Table 1a). the cob yield also increased significantly with T3 followed by T2 (Table 1a). Madhavi et.al. (1995) also reported higher grain yield of maize with 50% recommended NPK coupled with manure @ 4.5 t/ha(100 % NPK 120 : 60 : 60 kg/ha N : P2O5 : K2O). Kapur and Rana (1980) while working in Punjab noted that application of 120 kg. N/ha as calcium ammonium nitrate gave a yield of 31.9 q/ha compared with an almost equal yield obtained with 60 kg. N supplemented with 12 tonnes of FYM/ha.

On yield components - number of grains/cob, test weight

Maximum number of grains/cob was obtained with T2 treatment (50 % NPK + 10t/ha FYM) followed by T3 treatment but they are not differed significantly. Higher test weight of maize was recorded with T4 followed by T2 and T3 treatments with significant difference among themselves (Table 1a). Like grain yield, higher net production value and benefit: cost ratio were associated with T3 treatment while fertilizer use efficiency was found maximum with T5 (only FYM @ 10t/ha) followed by T3treatment (Table 1b). Hence, 75 % of the recommended NPK along with farm yard manure @ 10t/ha was found tp produced grain yield as well as higher benefit: cost ratio and net production value of maize in the Darjeeling hills.

Approach -2 : Studies on effect of different inter-crop combinations on yield and yield components of maize

Inter-crop combination effect on grain and cob yield

Inter-cropping systems showed significant effect on both grain as well as cob yield of maize during both the year of experimentation (Taable 2a). paired row arrangement of greengram I between two maize rows (T4) produced higher grain yield followed by T7 (monoculture), T3 (maize : laffa - 1:1) and T1 (maize : greengram-1:1) without significant difference among themselves. Zamr and Giambastiani (1996) found higher grain yield of maize under intercropping system with soybean as compared to pure stand with land equipment ratio 1.09 to 1.11. higher cob yield was obtained with T1 (maize : greengram - 1:1) followed by T2 (maize : groundnut - 1:1) and T3 (mai ze : alfa - 1:1) treatments but they did not differed significantly (Table 2a)

On yield components - number of grains/cob and test weight

Number of grains/cob did not vary significantly due to different inter-cropping systems, although higher number of grains/cob was recorded with T4 (maize : green in paired row) treatments (Table 2a). However, test weight was significantly affected with intercropping systems where maximum test weight was given by T2 followed by T3 and T1 with insignificant variations. Among the maize based intercropping systems, green gram in paired row arrangement in between two rows of maize was found compensatory in respect of net production value, benefit : cost ratio and land equivalent ratio (Table 2b).

Approach -3 : Studies on suitability of maize varieties under different altitudinal situation

In the mid-hills (Kalimpong), all the composit varieties took 118-140 days to mature and their production potentialities also varied from28.00q/ha (JM12) to 44.00q/ha(RCM-1-3) but from farmer's acceptance point of view, RCM -1-2 ranked first followed by RCM -1-3 (Table 3a and 3b) whereas in the higher hills (Pedong region), the composite variety VL16 produced higher yield with ranking first to the farmer's choice too. Along with VL16, Prodeced higher yield with ranking first to the farmer's choice too along with VL16, the hybrid variety HIM 129 took 80-90 days to attain their harvestable stage which enable the farmers to transplant wither paddy seedling in time and those varieties also produced higher grain yield as compared to local varieties having more than 150 days duration.

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Table 1a. Effect of different integrated nutrient supply systems on yield and yield components of Maize (Mean of 1998 and 1999)

Treatment*	Grain yield (q/ha)	Cob yield (q/ha)	No. if grains/cob (g)	Test weight
T_1	27.48	58.41	3605	28.64
T_2	29.65	74.01	405	30.09
T_3	37.34	92.00	388	29.94
T_4	33.71	60.99	350	30.63
T_5	25.25	58.50	348	29.18
T_6	18.04	34.25	265	22.43
SEM(±)	1.81	7.40	24.87	1.57
CD	3.97	15.98	53.71	3.41

* T1- 25% Rec. NPK + 100 % Rec. FYM, T2 - 50 % R. NPK + 100% R.FYM, T3 - 75 % R. NPK + 100% R.FYM, T4 - 100 % R. NPK + 100% R.FYM, T5 - 100% R.FYM, T6- without NPK and FYM

Table 1b. Economic analysis of different integrated nutrient supply system on maize

Treatment*	Investment (Rs./ha)	Gross Return (Rs./ha)	Net Production (Rs./ha/ Rupee investment)	Benefit:Cost Ratio	Fertilizer use efficiency (Rs./ha/ Rupee of fertilizer use)
T_1	8037.00	41,220.00	5.13	4.13	10.66
T_2	8904.00	44,475.00	4.99	3.99	09.39
T_3	9771.00	56,010.00	5.73	4.73	09.99
T_4	10,640.00	50,565.00	4.75	3.75	07.81
T_5	7170.00	37,875.00	5.28	4.28	12.62
T_6	4170.00	21,060.00	5.05	4.05	-

* same as Table 1a

Table 2a. Effect of different inter-crop combinations on yield and yield components of Maize cv. NLD (Mean of 1998 and 1999)

Treatment*	Grain yield (q/ha)	Cob yield (q/ha)	No. if grains/cob(gm)	Test weight
T_1	33.72	52.47	365	33.52
T_2	31.04	52.41	325	37.36
T_3	33.83	51.62	306	34.78
T_4	36.17	42.57	409	32.34
T_5	26.43	44.77	385	33.94
T_6	28.29	39.59	332	32.61
T_7	34.25	44.78	361	29.77
SEM(±)	1.76	3.01	72.03	1.97
$CD_{0.05}$	3.80	6.50	NS	4.27

* T1- Maize (M) : green gram (gg) - 1:1,T2 - M : Groundnut (gn) - 1:1, T3 - M : Laffar (l) - 1:1, T4 - M : gg - paired row (pr), T5 - M : gn -Pr., T6- M : 1-Pr, T7 - M , sole crop

Table 2b. Economic analysis of different maize based inter-cropping systems

Treatment*	Investment (Rs./ha)	Gross Return (Rs./ha)	Net Production (Rs./ha/ Rupee investment)	Benefit:Cost Ratio	Land Equivalent Ratio (LER)
T_1	11,240	50,580	4.50	3.50	0.98
T_2	12,140	46,560	3.83	2.83	0.91
T_3	11,240	50,745	4.51	3.51	0.99
T_4	11,240	54,255	4.83	3.83	1.06
T_5	12,140	39,645	3.26	2.26	0.77
T_6	11,240	42,435	3.77	2.77	0.82
T_7	10,840	51,375	4.74	3.74	-

* same as Table 2a

Table 3a. Characteristics of some introduced maize varieties in the Darjeeling hills

Variety	Source	Altitudinal Situation	Duration (day)	Weight cob(g)	100seed weight (g)	Grain yield (kg/ha)
RCM-1-1	ICAR Com. Umiam	Mid hills (Kalimpong)	120	300	28.18	3900
RCM-1-2	"	"	120	160	20.19	3200
RCM-1-3	"	"	118 -120	350	28.00	4400
JM-8	JNKV	"	130-140	202	31.90	3375
JM -12	"	"	"	180	29.00	2800
VL-16	VPKAS Almora	Upper hills (Pedong)	80-90	300	36.00	4375
HIN 129	"	"	85-90	209	27.00	3575

Table 3b. Farmer's acceptance analysis

Variety Introduced	Seed Colour	Seed size and shape	Market demand	Consumability	Farmer's Acceptence	Averageg grand point	Remarks with ranking
VL 16	Yellow	5	5	5	5	5.0	suitable in rice-maize sequence
HIM129	Yellow	4	5	4	5	4.5	Like VL 16
RCM-1-1	White	5	3	4	4	4.0	High yielder than local white seeded variety
RCM-1-3	White	5	4	4	5	4.5	Shorter height, non lodging, good fodder
RCM1-2	Yellow	5	5	5	5	5.0	Cob size larger than local pop corn
JM-8	White	5	3	4	4	4.0	High yielder than local white seeded variety
JM-12	White	5	3	3	3	3.5	Like JM-8

* 1 - 1 to 20 %, 2 - 21 to 40 %, 3 - 41 to 60 %, 4 - 61 to 80 %, 5 - above 80 %