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INVESTIGATION OF THE POTENTIALITY OF DUAL PURPOSE MAIZE

GAURI MOHAN*, KHOGEN KURMI, KUMUDESWAR THAKURIA, KAJODMAL GHASAL AND CHAYANIKA BORAH

Department of Agronomy,
Assam Agricultural University,
Jorhat (Assam), India
**(e-mail : gaurimohan123@gmail.com)*
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SUMMARY

The present study was under taken to find out the potentiality of maize for dual purpose to enhance the food–fodder production under different plant population. The experiment was laid out in factorial RBD and replicated thrice. The treatment consisted of eight crop management practices viz., Grain crop at 60 cm x 30cm (T1), Fodder crop at 30 cm x15 cm (T2), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at knee-high stage for fodder (T3), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at tasseling stage for fodder (T4), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at milking stage for fodder (T5), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at knee-high stage for fodder (T6), Fodder cum grain crop (30 cm x 15 cm) removal of alternate row at tasseling stage for fodder (T7), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at milking stage for fodder (T8) and two levels of fertilizer viz., F1: 100% of RDF and F2: 150% of RDF. Experimental findings revealed that the crop management practices differed significantly with respect to growth, yield and yield attributing characters both grain and fodder maize. The highest grain and stover yield being 34.21 q/ha and 105.52 q/ha, respectively was produced from T1 which was *at par* with crop management practice T6, T7 and T8. However, green fodder yield (164.04 q/ha) and dry matter yield (35.31 q/ha) was found to be highest in crop management practice T2. Among the fertilizer levels F2: 150% of RDF recorded the highest green fodder yield (79.68 q/ha), dry matter yield (16.19 q/ha), grain yield (31.98 q/ha) and stover yield (95.93 q/ha) of dual purpose maize.

Key words : Maize, knee- heigh stage, tasseling stage, milking stage

Among the various fodder crops, maize (*Zea mays* L.) is one of the most important dual crops grown widely in *kharif* season for grain as well as for fodder. The crop has an edge over other cultivated crops due to its high production potential ability, wider adaptability, quick growing nature, succulence, palatability, excellent fodder and free from toxicants and it can be safely fed to animals at any stage of crop growth (Mahdi *et al*., 2010). In India also maize production is rapidly increasing largely due to the growing poultry and dairy industry. Use of maize forage as animal feed becoming very important for small scale mixed farming in different parts of our country. This type of forage contributes up to 24% of the total cattle feed thus making maize production for grain and fodder equally important. The inability of the livestock keepers to feed their animals adequately throughout the year remains the major technical constraints in most livestock based farming systems particularly in smallholders. Meeting the demands for eggs, meat and milk in a way that poor livestock keepers benefit more from their animal assets will require sustainable production of more and higher quality feed. In such situation technology for dual purpose maize may be the suitable option to meet the demands of this crop for both grain as well as good quality fodder yield (Grings *et al.*, 2013).

MATERIALS AND METHODS

To see the agro-economic response of maize to added N, P_2O_5, K_2O and removal of extra plants at different stages of crop for fodder the experiment was conducted at the Instructional-Cum-Research Farm of Assam Agricultural University during 2016-17 on a sandy loam soil having 210.65 kg N ha^{-1}, 38.64 kg ha^{-1} of available phosphorous and 295.55 kg ha^{-1} available potassium. The pH of the soil was 5.15. The experiment was laid out in factorial RBD and replicated thrice. The treatment consisted of eight crop management practices *viz.*, Grain crop at 60 cm x 30cm (T_1), Fodder crop at 30 cm x15 cm (T_2), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at knee-high stage for fodder (T_3), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at tasseling stage for fodder (T_4), Fodder cum grain crop at 30 cm x 30 cm with removal of alternate rows at milking stage for fodder (T_5), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at knee-high stage for fodder (T_6), Fodder cum grain crop (30 cm x 15 cm) removal of alternate row at tasseling stage for fodder (T_7), Fodder cum grain crop at 30 cm x 15 cm with removal of alternate rows at milking stage for fodder (T_8) and two levels of fertilizer *viz.*, F_1: 100% of RDF and F_2: 150% of RDF. [NB: Recommended dose of fertilizer (RDF) = 60-40-40 N- P_2O_5- K_2O kg/ha]

The dual purpose maize hybrid variety PAC 751 was taken as test crop for assessing its performance. The seed was sown on a well prepared seedbed. Quantity of seeds required for different treatment was calculated according to the area of the individual plot and sowing was done in lines at spacing of 60 cm x 30 cm, 30 cm x 30 cm and 30 cm x 15 cm. At the time of final land preparation, well decomposed FYM @ 5 tones ha^{-1} was applied in the field and thoroughly incorporated before laying out the experiment. The total quantity of P and K and one-third (1/3) of nitrogen at sowing was applied and remaining two-third (2/3) of N in two equal doses at knee-high stage and at tasseling was applied as per treatment. Harvesting of fodder maize was done at different stage (knee-high stage, tasseling stage and milk stage) in alternate rows as per treatments. All other agronomic practices were kept normal and uniform for all the treatments. Data on agro-economic aspects of the crop were recorded and were analysed statistically and differences among treatment means were tested using -test at 5% level of significance.

RESULTS AND DISCUSSION

The crop management practices and fertilizer levels affected significantly the crop characteristics namely leaf-stem ratio, green fodder yield (q/ha), dry matter content (%), dry matter yield (q/ha), number of rows per cob, number of kernels per row, number of kernels per cob, 1000 grain weight (g), stover yield (q/ha), grain yield (q/ha) and harvest index (%). Application of different crop management practices did not show any significant effect on leaf–stem ratio of green fodder production of dual purpose maize. However, the highest (0.71) and lowest (0.50) values leaf–stem ratio were registered in dual purpose maize grown at a spacing of 30cm x 30cm and subsequent removal of alternate rows at milking (T_5) and knee-high stages (T_3), respectively (Table1). The effect of different levels of fertilizer did not bring any significant difference in leaf-stem ratio of dual purpose maize. However, the leaf-stem ratio was found to be comparatively higher when the crop was supplied with 150 per cent of recommended fertilizer dose for the crop (Table 1).

TABLE 1

Effect of crop management practices and levels of fertilizer on fodder parameter of dual purpose maize

Treatment	Leaf-Stem ratio	Green fodder yield (q/ha)	Dry matter content (%)	Dry matter yield (q/ha)
Crop management (T)				
T_1 : Grain (G)	-	-	-	-
T_2 : Fodder (F)	0.67	164.04	21.50	35.31
T_3 : F at KHS* with S1+G	0.50	12.13	17.50	2.18
T_4 : F at TS with S_1+G	0.62	63.90	19.50	11.95
T_5 : F at MS with S_1+G	0.71	74.18	22.00	16.21
T_6 : F at KHS with S_2+G	0.58	21.76	18.33	3.97
T_7 : F at TS with S_2+G	0.65	78.31	20.50	15.96
T_8 : F at MS with S_2+G	0.68	87.15	20.83	17.94
S. Em±	0.05	3.72	1.33	0.99
C. D. (P=0.05)	NS	10.80	NS	2.87
Levels of fertilizer (F)				
F_1 (100% of RDF)	0.59	63.59	19.90	13.19
F_2 (150% of RDF)	0.66	79.68	20.14	16.19
S. Em±	0.03	1.99	0.71	0.53
C. D. (P=0.05)	NS	5.79	NS	1.54
Interaction (T× F)				
S. Em±	0.05	3.72	1.33	0.99
C. D. (P=0.05)	NS	NS	NS	NS

*KHS: Knee-high Stage, TS: Tasseling Stage, MS: Milking Stage, S1: 30 cm x 30 cm spacing and S2: 30 cm x 15 cm.

Significant variations in fodder parameter were recorded due to different crop management practices. Green fodder yield (164.04 q/ha) (Fig. 1) and dry matter yield (35.3 q/ha) were significantly highest in fodder crop sown at spacing of 30cm x 15cm (T_2) over all other crop management practices (Table 1). In this practice all the maize plants were harvested for fodder purpose at tasseling stage. But other crop management practices only alternate rows were harvested for fodder purpose at different growth stages. The crop rectangularity (30cm × 15cm) and plant density (2,22,222 plants ha^{-1}) resulted from this spacing might be optimum to result in better light absorbance by more number of flag leaves which have higher photosynthesis efficiency and enhanced green fodder yield as described by Tetio-Kagho and Gardnar (1988). Application of 50 per cent higher fertilizer over recommended level resulted in significantly higher green fodder yield (79.68 q/ha) and dry matter yield (16.19 q/ha) (Table 1). This might be due to the fact that the maize has the capacity to utilize all applied levels of fertilizer since maize crop is a heavy feeder of nutrients. This was in conformity with Aslam (2007), who observed maximum green fodder yield with 150 kg N/ha. Sahoo and Panda (2001) reported that green fodder yield of maize increased with increasing levels of fertilizer. Similar results of higher green fodder and dry matter yield were also obtained by Ramachandrappa *et al*. (2004).

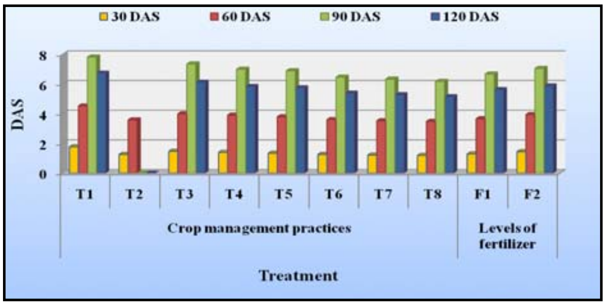

Fig. 1. Effect of crop management practices and levels of fertilizer on green fodder yield of dual purpose maize.

Among the crop management practices grain crop at a spacing of 60 cm x 30cm (T_1) produced significantly the highest cob parameters like number of kernels per row (40.17), number of kernels per cob (655.67) and 1000 grain weight (245.83 g) (Table 2). The number of kernels per row is an important cob parameter. Number of kernels per row was significantly influenced by spacing. Number of kernels per row increased with increasing spacing. Abuzar *et al*. (2011) and Andrade *et al.* (1993) observed that an increase in plant density decrease the number of kernels per row and grains or kernels per cob in maize. 1000-grain weight was significantly influenced by plant spacing and was increased with increasing spacing. The result was supported by Biswas *et al.* (1991), where they found that decreased 1000-grain weight with decreasing spacing. The increase in all these characters in T_1 might be due to the availability of all the resource at adequate amount at T_1 crop management practice, which helped in higher

TABLE 2

Effect of crop management practices and levels of fertilizer on cob parameter of dual purpose maize

Treatment	No. of rows/cob	No. of kernels/ row	No. of kernels/ cob	1000-grain weight (g)
Crop management (T)				
T_1 : Grain (G)	16.33	40.17	655.67	245.83
T_2 : Fodder (F)	-	-	-	-
T_3 : F at KHS* with S_1+G	15.33	37.00	558.74	238.48
T_4 : F at TS with S_1+G	15.00	36.50	556.35	237.43
T_5 : F at MS with S_1+G	15.00	35.83	549.33	234.80
T_6 : F at KHS with S_2+G	14.67	33.17	478.67	228.44
T_7 : F at TS with S_2+G	14.33	33.00	473.67	227.48
T_8 : F at MS with S_2+G	14.33	32.50	466.00	227.22
S. Em±	0.48	0.55	19.19	3.39
C. D. (P=0.05)	NS	1.61	55.79	9.85
Levels of fertilizer (F)				
F_1 (100% of RDF)	14.67	34.81	510.31	231.27
F_2 (150% of RDF)	15.33	36.10	557.81	237.22
S. Em±	0.26	0.3	10.25	1.81
C. D. (P=0.05)	NS	0.86	29.88	5.28
Interaction (T× F)				
S. Em±	0.48	0.55	19.19	3.39
C. D. (P=0.05)	NS	NS	NS	NS

*KHS: Knee-high Stage, TS: Tasseling Stage, MS: Milking Stage, S1: 30 cm x 30 cm spacing and S2: 30 cm x 15 cm.

photosynthetic and metabolic activities of plant, resulting increase in cob parameter, which directly helps in increasing yield. The findings can be corroborated with the findings of Asghar *et al.* (2010), Thavaprakaash *et al.* (2008), Randhawa and Khan (2007) and Thakur *et al.* (1997). Cob parameter *viz.* number of kernels per row (36.10), number of kernels per cob (557.81) and 1,000 grain weight (237.22 g) showed a positive response to the increasing levels of fertilizer (Table 2). Increase in nitrogen level, increased the yield attributes by better uptake of all the nutrients and increased translocation of photosynthates from source to sink in hybrid maize (Srikanth *et al.*, 2009). The same trend was observed up to 200 kg nitrogen by Parthipan (2000) and 225 kg nitrogen by Singh *et al.* (1997). The findings were in conformity with Hanif (2007) who had concluded that yield and quality parameters were improved with increased nitrogen and phosphorous levels.

Yield parameter like grain yield (34.21 q/ha) and stover yield (105.52 q/ha) were found to be highest in grain crop at a spacing of 60cm x 30cm (T_1) (Table 3) (Fig. 2). Inter and intra row spacing in this management practice might be favourable for minimizing competition for resource *viz.*, water, nutrients, space and light which result in stover and grain yield. Grain yield is the main target of crop production. Plant spacing significantly influenced the grain yield of maize. Moriri *et al.* (2010) reported that grain yield increased with increase plant density. Significant positive effect of N-P_2O_5-K_2O on grain yield (31.98 q/ha) and stover yield (95.93 q/ha) were observed with increasing levels of fertilizer (Table 3) (Fig. 2). This might be due to the higher response of maize plants towards higher levels of fertilizer which resulted in higher yield and yield attributing characters. Similar results were observed by Hanif (2007) who concluded that increase in yield was mainly due to increase in growth parameters with respect to the increased in levels of nitrogen and phosphorous up to 150-100 kg/ha. This result was in conformity with Jogdand *et al.* (2008). Similar results were also

TABLE 3A
Interaction effect of crop management practices and levels of fertilizer on grain yield (q/ha) of dual purpose maize

Crop management (T)	Grain yield (q/ha)	
	Levels of fertilizer	
	F_1 (100% of RDF)	F_2 (150% of RDF)
T_1 : Grain (G)	31.86	36.55
T_2 : Fodder (F)	-	-
T_3 : F at KHS* with S_1+G	16.74	34.78
T_4 : F at TS with S_1+G	21.62	25.71
T_5 : F at MS with S_1+G	22.88	23.41
T_6 : F at KHS with S_2+G	29.51	34.87
T_7 : F at TS with S_2+G	27.72	34.49
T_8 : F at MS with S2+G	27.17	34.06
S. Em±	1.33	
C. D. (P=0.05)	3.86	

*KHS: Knee-high Stage, TS: Tasseling Stage, MS: Milking Stage, S_1 : 30 cm x 30 cm spacing and S_2 : 30 cm x 15 cm.

TABLE 3
Effect of crop management practices and levels of fertilizer on yield parameter of dual purpose maize

Treatment	Grain yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
Crop management (T)			
T_1 : Grain (G)	34.21	105.52	30.63
T_2 : Fodder (F)	-	-	-
T_3 : F at KHS* with S_1+G	25.76	87.61	30.09
T_4 : F at TS with S_1+G	23.67	82.60	30.07
T_5 : F at MS with S_1+G	23.15	77.19	30.35
T_6 : F at KHS with S_2+G	32.19	104.19	30.69
T_7 : F at TS with S_2+G	31.10	95.04	32.16
T_8 : F at MS with S_2+G	30.62	89.27	32.66
S. Em±	1.33	1.89	1.75
C. D. (P=0.05)	3.86	5.50	NS
Levels of fertilizer (F)			
F_1 (100% of RDF)	25.36	87.33	30.13
F_2 (150% of RDF)	31.98	95.93	31.77
S. Em±	0.71	1.01	0.94
C. D. (P=0.05)	2.07	2.94	NS
Interaction (T × F)			
S. Em±	1.33	5.50	1.75
C. D. (P=0.05)	3.86	NS	NS

*KHS: Knee-high Stage, TS: Tasseling Stage, MS: Milking Stage, S1: 30 cm x 30 cm spacing and S2: 30 cm x 15 cm.

reported by Rasheed *et al*. (2004). The interaction effects of different crop management practices and levels of fertilizer were found to be significant in respect of grain yield of maize (Table 3.a.). Significantly the highest grain yield (36.55 q/ha) was recorded with the grain crop sown at a spacing of 60 cm x 30 cm and fertilized with 90- 60-60 kg N- P_2O_5-K_2O/ha (T_1 F_2) which remained *at par* with all the crop management practices combined with 50 per cent higher level of NPK fertilizers except fodder cum grain crop sown at 30cm x 30cm spacing with removal of alternate rows at tasseling (T_4F_2) and milking (T_5F_2) stages. The lowest grain yield (16.74q ha^{-1}) was recorded with the fodder cum grain crop sown at a spacing of 30cm x 30 cm and removal of alternate rows at knee-high stage for fodder and supplied with RDF (application of crop management practice (T_3F_1).

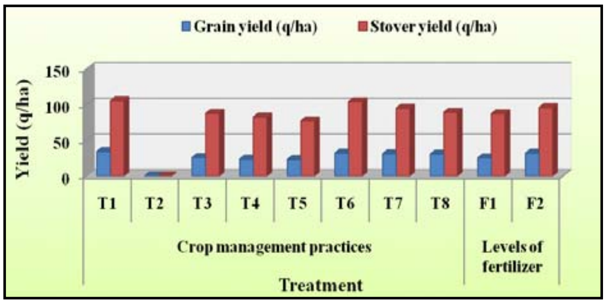

Fig. 2. Effect of crop management practices and levels of fertilizer on grain yield and stover yield of dual purpose maize.

CONCLUSION

Based on the results of the experiment, it can be concluded that among all the crop management practices as the sole grain crop (T_1) resulted highest grain yield (34.21 q/ha) which was closely followed by T_6 (32.19 kg/ha), T_7 (31.10 kg/ha) and T_8 (30.62 kg/ha) which is decreased by 5.90%, 9.09% and 10.49%, respectively from the yield of sole grain crop. Along with grain yield, these treatments also produced fodder yield @ 86.73%, 52.26%, and 46.87% of pure fodder crop. This study has shown that with proper seeding densities and thinning regime production of both fodder and grain is possible.

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