EFFECTS OF INTERCROPPING, SEEDLING RATE AND FERTILIZER ON FODDER PRODUCTION IN THE LOW LYING AREA OF BANGLADESH

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Summary

The study was conducted at low lying areas in Pabna and Sirajgong districts of Bangladesh. To observe the potentiality of bio-mass production two trials were conducted. In first trial maize intercropped with Khesari taking 15 experimental plots of each size 5m × 5m were arranged in 5 blocks having homogenous soil characteristics. The study showed that the bio-mass yield of sole maize and sole Khesari were 35.25 t/ha. and 56.80 t/ha respectively and there was a significant difference ($p < 0.01$) among them. The results also showed that bio mass yield of maize and Kherasi was higher (70.04 ± 6.25 t/ha, 98.88 ± 10.77 t/ha and 80.56 ± 9.5 t/ha) compared to sole maize and sole Khesari and land equivalent ratio was also lower.

For second trial, one hectare of land was divided into 16 experimental plots with 4 replications in each plot. Four levels of urea (0 kg/ha, 30 kg/ha, 45 kg/ha and 60 kg/ha.) were applied to experimental plots. The seed rates were 98.8 kg/ha (farmer's practice), 86.45 kg/ha, 74.1 kg/ha and 61.75 kg/ha. Average bio-mass yield of matikalai at different seed rates along with urea fertilizer ranged from 38.49 t/ha, to 65.35 t/ha. The highest seed rate along with highest fertilizer also correspond to the peak production (65.35 t/ha) and the lowest seed rate (61.75 kg/ha) along with the lowest fertilizer rate (30 kg/ha.) showed lowest production (38.49 t/ha.). Here, it was found that the bio-mass yield of matikalai increased with the incremental amount of seed, indicating significant effect ($p < 0.05$) of seed rates on the bio-mass yield of matikalai. On the other hand, fertilizer doses in different treatment combinations had significant effect ($p < 0.05$) on bio-mass yield. Two levels of seed rates at zero level of fertilizer were recommended : 86.45 kg/ha for the resource rich farmers and 61.75 kg/ha for the resource poor farmers.

(Key Words : Bio-mass, Land Equivalent Ratio, Intercropping)

Introduction

Shortage of feeds and fodder for livestock particularly for cattle and buffalo is the single most important constraint to livestock development in Bangladesh. Cattle and Buffalo subsist on a diet of straw, mostly paddy straw supplemented by what fodder remains to be found in the field boundaries, embankment, roadsides and around homesteads. Small quantities of additional livestock feed come from by-products of the village rice mill, and oil seed press, fresh sugarcane tops, molasses and some pulses grown as a mixed crop with the paddy during the winter. Cattle and buffalo are extremely dependent upon what is supplied to them by their owner for their feed since they are normally tethered in the homestead, and cannot scavenge for food as do the sheep, goat, chicken and duck

For raising of livestock and to increase their productivity level, it is imperative to produce quality feeds and fodder for animals. With the increased use of chemical fertilizer, total bio mass production, and nutritive values of grasses and fodder crops may be considerably changed in different times of the year.

At low lying areas (Bathan) of Bangladesh, the cattle mainly live on winter legumes like matikalai, khesari during November to March which are grown abundantly in the seasonal pasture land. These seasonal legumes significantly contribute to increase milk production in this area. Farmers of Bathan area have been cultivating these two main fodder crops which broadcasted on the Bathan land immediately after the recedence of flood water without any recommended fertilizer doses and seed rates. For consid-

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ering benefits of the farmers, in addition to matikalai (Vigna mungo), and maize (Zea mays) intercropped with khesari (Lathyrus sativas), higher biomass of forage is obtained in comparatively shorter period. Moreover, maize plants gives shed for khesari plants for better growth and benefitting the soil from constant depletion when intercropped with khesari. Suitable crop rotations in the multiple cropping help in reducing the weed population (Rahman et al., 1991) and intercropping of forage crops have been found more profitable than mixture (Narwal et al., 1988).

Thus, the total fodder production of maize intercropped with khesari is expected to be more in quantity and quality than either sole maize and sole khesari which could be fed to more number of cattle.

In view of the above importance the experiment on biomass fodder production of matikalai, and maize intercropped with Khesari were undertaken at low lying areas of Bangladesh.

Materials and Methods

The experiment was conducted at the low lying areas of Pabna and Sirajgong districts over a period of 2 years. Previous work had indicated potential of legume fodder supplementation to increase milk production.

First experiment

This study was conducted at non-Bathan area of Pabna milk shed area, taking 15 experimental plots of each size 5m × 5m, and arranged in 5 blocks having homogenous soil characteristics. The experimental plots were prepared by ploughing and subsequent cross ploughing and harrowing. A prescribed basal dose of 175 kg/ha of tripple super phosphate, 45 kg/ha of muriate of potash and 25 tons/ha of FYM (Farm yard manure) were applied in the experimental plots during land preparation and 55 kg urea/ha was applied after 6 weeks of sowing. The intercrops were grown in three spatial arrangements, i.e. seeds were dibbled in 100 × 25 cm, 75 × 25 cm, and 50 × 25 cm, and khesari seeds were broadcasted in between the rows. Sole maize and sole khesari were also introduced as spatial treatment for comparison. Maize samplings were thinned first at 50 days after emergence (DAE) and final harvest was done after 7 days of cob at milking stage and khesari was also harvested after 70 days of sowing. Data were analyzed for appropriate statistical variances according to Snedecor and Cochran (1982), using SAS package.

Land Equivalent Ratio (LER) was determined according to the following formula by Willey (1979).

$$LER = \frac{\text{Intercropped yield of crop A}}{\text{Sole crop yield of crop A}} + \frac{\text{Intercropped yield of crop B}}{\text{Sole crop yield of crop B}}$$

Second experiment

The second experiment was carried out on Bathan land and about 1 hectare land was divided into 16 experimental plots with 4 replications in each plot. Four levels of urea (0 kg/ha, 30 kg/ha, 45 kg/ha and 60 kg/ha) were applied as basal along with 4 levels of seed rates of matikalai viz. 98.8 kg/ha, 86.45 ka/ha, 74.1 kg/ha and 61.75 kg/ha. Farmer's practice was 98.8 kg/ha. Thus, a total of 16 treatment combinations of fertilizer and seed were assigned randomly to 16 different plots. The seed was broadcasted on 28th October, 1991 and was harvested on the 31st December, 1991.

For the determination of bio-mass, 4 m^2 from each plot of matikalai was harvested randomly and data on fresh bio-mass of matikalai were analyzed using a 4 × 4 factorial experiment (Steel and Torrie 1964) and for variance analysis the statistical analysis System (SAS, 1982) was used.

Results and Discussion

First experiment

The fresh yield of green maize intercropped with khesari as fodder is presented in table 1. It was observed that the yield of green maize as sole crop was 35.35 t/ha which did not differ significantly ($p > 0.01$) when intercropped with Khesari in differents combinations. The result with respect to khesari was however different. The yield of khesari was 56.80 t/ha as sole crop and differs significantly ($p < 0.01$) when intercropped with maize. The results also revealed that the fresh total biomass yield of maize and Khesari was considerably higher in different row combi-

nations (70.04 ± 6.25 t/ha, 98.88 ± 10.77 t/ha, and 80.56 ± 9.5 t/ha) compared to sole maize (35.35 t/ha) and sole khesari (58.80 t/ha). In the variance analysis interaction values showed that highest yield of fresh maize fodder and Khesari was obtained at 100 × 25 cm spacing, the yield difference however was not significant ($p < 0.05$). This higher biomass yield may be attributed to optimum row spacing that allowed the fodder crop to thrive well interms of nutrients uptake from soil and solar and a companion with leguminous intercrop to interact as a positive effect to main crop. Thus, fodder maize and khesari combination in a multiple cropping system is a promising practice and can be extended to forage based animal production. The land equivalent ratio (LER) was lower in the sole maize and sole khesari but increased in the intercropping practices. Similar results were observed by Mac coll, (1989) and Thakur and Sharma (1988).

TABLE 1. FRESH YIELD (t / ha) OF MAIZE AND KHESARI WITH AND WITHOUT INTERCROPPING

Cropping method	Maize	Khesari	Total	LER
Maize (sole)	$35.35^{a} \pm 1.9$		$35.35^{d} \pm 1.91$	1.00
Khesari (sole)	–	$56.80^{a} \pm 3.4$	$56.80^{cd} \pm 3.4$	1.00
Maize + khesari (50 × 25 cm)[1]	$35.72^{a} \pm 1.2$	$44.84^{b} \pm 1.0$	$80.56^{ab} \pm 9.5$	1.79
Maize + khesari (75 cm × 25 cm)[2]	$28.88^{a} \pm 0.9$	$41.20^{b} \pm 2.4$	$70.04^{bc} \pm 6.2$	1.54
Maize + khesari (100 cm × 25 cm)[3]	$37.00^{a} \pm 3.6$	$61.88^{a} \pm 4.2$	$98.88^{a} + 10.7$	2.13

* Symbols having same letters in the same columns did not differ significantly ($p > 0.05$) and LER means Land Equivalent Ratio.

[1] Maize row to row spacing 50 cm and plant to plan spacing 25 cm.

[2] Maize row to row spacing 75 cm and plant to plan spacing 25 cm.

[3] Maize row to row spacing 100 cm and plant to plan spacing 25 cm.

Second experiment

The average biomass yield of matikalai to different seed rates along with urea basal is exhibited in table 2 and figure 1. From the table, it was observed that the yield of fresh bio-mass of matikalai ranged from 38.49 t/ha to 65.35 t/ha. It was also observed that the highest seed (98.9 kg/ha) rate along with the highest fertilizer dose (60 kg/ha) corresponded to peak production (65.35 t/ha). One plausible explanation for this is that higher amount of seed rate produced the highest plant population and enhanced plant growth due to higher nitrogen uptake by the plant among all combinations. Similar results were found by Rahman et al. (1993) in Bangladesh and Bangarwa et al. (1988) in all-India Coordinated Maize Improvement Project (ICAR) with relatively higher fertilizer doses. The lowest seed rate (61.75 t/ha) along with the lowest fertilizer dose (30 kg/ha) gave the lowest fresh bio-mass production. This finding is in agreement with the results of Vaughan et al. (1979, 1980) who applied only 69.9 kg urea/ha with a higher quantity of seed/ha.

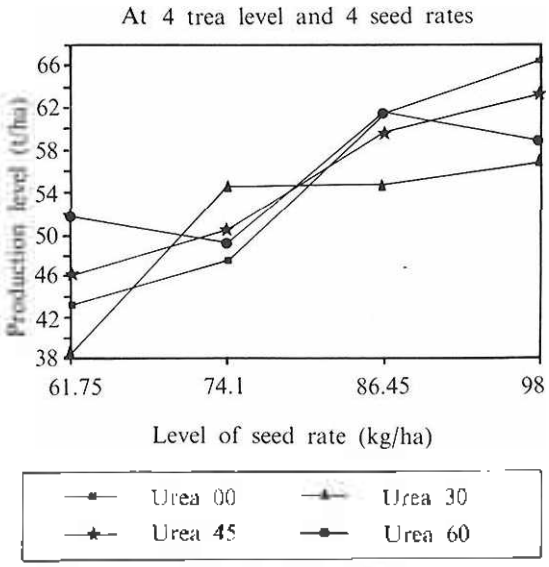

Figure 1. Bio-mass production of matikalai.

TABLE 2. PRODUCTION PERFORMANCE OF MATIKALAI ACCORDING TO DIFFERENT FERTILIZER DOSES AND SEED RATES (1991-92)

Urea (kg/ha)	Seed rate (kg/ha)	Yield (t/ha)	Mean yield (t/ha)	S.D
00	61.75	38.48-49.61	44.04	5.56
	74.1	41.54-52.74	47.14	5.6
	86.45	59.72-63.43	61.57	1.85
	98.8	57.83-60.35	59.09	1.26
30	61.75	33.54-43.44	38.49	4.95
	74.1	52.47-58.19	55.33	2.86
	86.45	50.04-58.62	54.33	4.29
	98.8	48.46-60.05	54.25	5.79
45	61.75	42.53-52.04	47.28	4.75
	74.1	44.23-51.81	48.02	3.79
	86.45	56.41-63.34	59.87	3.46
	98.8	62.54-65.43	63.98	1.44
60	61.75	44.65-55.26	49.95	5.30
	74.1	49.16-50.04	49.60	0.44
	86.45	57.48 64.78	61.13	3.65
	98.8	63.35-67.36	65.35	2.00

TABLE 3. PRODUCTION AND BENEFIT COST ANALYSIS OF MATIKALAI

Seed (n1) (kg/ha)	Urea (n2) (kg/ha)	Production (Y) (t/ha)	Total output (Tk)**	Total input cost (Tk.)*	Benefit cost ratio
61.75	00	44.04	27,525	864	31.83
74.1	00	47.14	29,462	1,037	28.40
86.45	00	61.57	38,481	1,210	31.79
98.8	00	59.09	36,931	1,383	26.69
61.75	30	38.49	24,056	1,014	23.71
74.1	30	55.33	34,581	1,187	29.12
86.45	30	54.33	33,956	1,360	24.96
98.8	30	54.25	33,906	1,533	22.11
61.75	45	47.28	29,550	1,089	27.12
74.1	45	48.02	30,012	1,262	23.77
86.45	45	59.87	37,418	1,435	26.07
98.8	45	63.98	39,987	1,608	24.86
61.75	60	49.95	31,218	1,164	26.80
74.1	60	49.60	31,000	1,337	23.17
86.45	60	61.13	38,206	1,510	25.29
98.8	60	65.35	40,843	1,683	24.26

* Total input cost includes price of urea (Tk. 500/kg) and seed (Tk. 14.00/kg).
** Value of the bio-mass is Tk. 25.00/40 kg.

Here, it was interesting to note that the bio-mass yield of matikalai increased with the incremental application of seed, indicating significant effect ($p < 0.05$) of seed rates on the bio-mass yield of matikalai. The effect of fertilizer rate in different treatment combinations also showed a significant effect on bio-mass yield, but figure 1, showed that there existed a linear production relationship between seed rate and bio-mass yield of matikalai. This was due to the

fact that the lower fertilizer and lower amount of seed rate produced lowest numbers of plant population which ultimately reduced the biomass production from matikalai.

Production and benefit cost analysis of matikalai is presented in table 3. It was revealed that zero level of urea and 86.45 kg/ha of seed rate produced higher amount of fresh bio-mass yield (61.57 t/ha) with reasonable production cost, although the highest biomass yield (65.35 t/ha) was obtained with respect to highest amount of seed and fertilizer rates. The main reason for yield reduction from 65.35 to 61.57 t/ha is due to the application of lower seed rate and no fertilizer compared to higher seed rate (98.8 kg/ha) and fertilizer (60 kg/ha). Similar findings also reported by Bhan and Khan (1982). The benefit- cost ratio at this point was 31.19. The results further indicated that zero level of urea and 61.75 kg/ha of seed rate produced 44.04 t/ha of fresh biomass. In this point, benefit-cost ratio was 31.83, which was much more than the farmer's practice (26.69).

Conclusion

The results emanated from the studies have confirmed the potential of cultivation of seasonal fodder which can be obtained only 70-90 days in the field and can be well included in the existing cropping system. Zero level urea with 86.45 kg/ha of seed rate may be recommended for resource rich farmer and zero level urea along with 61.75 kg/ha of seed rate may be recommended for resource poor farmers and this could save not only seed cost but also fertilizer cost.

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