HERBAGE YIELD AND NUTRIENT COMPOSITION OF FODDERMAIZE BASED INTERCROPPING SYSTEM IN RAINFEDSITUATION OF SOUTHERN TRANSITION ZONE

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Abstract - The present study aimed to evaluate the herbage yield and nutrient composition of fodder maize-based intercropping in rainfed situation of southern transition zone. The treatment comprised of sole fodder maize, fodder maize-based intercropping with different legumes (cowpea, horsegram, local fieldbean and guar) in 3:1 and 2:1 row ratio.Sole fodder maize recorded significantly higher growth parameter like plant height (285.60 cm), number of leaves (14.13), leaf area (52.37 dm^2 $plant^{-1}$) and dry matter accumulation (236.34 g $plant^{-1}$). The intercropping treatment fodder maize + cowpea (3:1) recorded significantly higher green fodder yield (76.15 t ha^{-1}), dry fodder yield (25.34 t ha^{-1}) along with maximum nutrients uptake (290.76, 53.70 and 296.32 NPK kg ha^{-1} respectively). Further,quality parameters such as crude protein (9.81 and 14.51 %) ash content (10.09 %) ether extract (2.65 %) were found higher which is also recorded significantly lower crude fibre (20.13 and 19.58 %), neutral detergent fibre (75.97, 68.31 %) and acid detergent fibre (57.70, 41.36 %) was found in the above treatment. Higher net return (Rs.61,937 ha^{-1}) was also registered in fodder maize + cowpea (3:1) intercropping whereas, higher benefit cost ratio (3.08) was obtained with intercrop of fodder maize with cowpea (2:1).

I. INTRODUCTION

Quality forage production plays an important role in dairy industry. Availability of green forage to animals is the key for the success of dairy enterprises as it enables to maintain the health and milk production of the livestock evenly. Fodder and feeds are the major inputs in animal production especially in milch animals, which account for about 60 per cent of total cost of milk production. Presently the availability of green fodder is about 513 million tonnes projecting a deficit of 63 per cent over the demand of green fodder (Surve et al. 2011). Intercropping has been recognised as a beneficial system of crop production as well as one of the potent means of better utilization of resources and higher fodder production per unit area per unit time. Cereal- based forage diet has the potential to supply large amounts of energy for animal. However, they often contain less crude protein and for desirable levels of milk or meat production diets require additional protein supplementation. Inclusion of legumes along with cereals has been reported to improve the forage quality since legumes are rich in protein. There are numerous advantageous of intercropping, legumes with fodder maize that includes improved herbage quality, increased biomass production and economic use of fertilizers besides efficient utilization of land and minimizing the risk due to aberrant weather.

Maize (Zea mays L.) is one of the most important C4 crop plants and is considered an ideal cereal forage crop because of its quick growing, high yielding, palatable with nutritious qualities and lactogenic effect. The main aim of fodder maize production is to provide nutritious fodder in accordance with feed requirement of animal. Fodder legumes when mixed with fodder maize increases the protein content and tonnage of fodder with higher palatability (AOAC, 2001). Maize has the potential to supply large amounts of energy-rich forage for animal diets and its fodder can safely be fed at all stages of growth without any danger of oxalic acid, prussic acid as in case of sorghum (Dahmardehet al., 2009). Thus, forage maize has become a major constituent of ruminant rations in recent years, where its inclusion in dairy cow diets improves forage intake, animal performance and reduces production costs (Anil et al., 2000). The crude protein and fibre content of fodder is 7.0 to 8.5 per cent and 25 to 30 per cent in maize respectively and the crude protein content in legume fodder ranges between 16 to 21per cent. Although maize provides high yield in terms of dry matter, it produces forage with low protein content. However, protein is needed by livestock for growth and milk production. Protein is one of the important constituents of rumen bacteria which digest much of the feed for ruminant animals (GhanbariBonjar, 2000). Because of low protein content, maize hay is usually lower than that of required to meet satisfactory production levels for many categories of livestock (Lawes and Jones, 1971). Therefore, it is necessary to provide livestock with protein supplements when forage quality is low. The purchase of protein supplements is expensive and results in high feed costs because of that growing of legume with maize is helpful, legumes have high level of protein (about twice more than maize) content can be mixed with maize to improve forage protein content of diets and thus the costs of high-

quality forage production can be lowered. The growing of two or more crop species simultaneously with definite row proportion in the same field during a growing season is known as intercropping (Ofori and Stern, 1987) has many advantages over sole cropping. It provides an efficient utilization of environmental resources, reduces risk to the cost of production, provides greater financial stability for farmers, decreases pest damages, suppresses weed growth more than monocultures, improves soil fertility through increasing nitrogen (Willey, 1979). Intercropping of maize with different legumes observed that dry matter yield and crude protein yield of forage were increased by all intercropping systems as compared with the maize monoculture. (Dahmardehet al., 2009). Concerning to the above, commonly used farmer friendly legumes like cowpea, horsegram, local field bean and guar were used in this study. Information on forage production potential and nutritive value of fodder maize in intercropping with different legumes is meagre in Southern Transition Zone of Karnataka. Hence a field experiment was conducted during kharif, 2017 on sandy loam soils of Agricultural and Horticultural Research Station Bhavikere, Chikkamagalure district to study the performance of fodder maize intercropped with different legumes.

II. MATERIALS AND METHODS

A field experiment was conducted at Agricultural and Horticultural Research Station Bhavikere, UAHS, Shivamogga during kharif 2017 to study the herbage yield and nutrient composition of fodder maize-based intercropping in rainfed situation of southern transition zone. The texture of the soil is sandy loam having acidic pH (5.25) with low organic carbon (0.40 %) and available nitrogen (220.80 kg ha^{-1}), phosphorous (33.90 kg ha^{-1}) and potassium (163.60 kg ha^{-1}) status. The test variety for maize was South African Tall. The experiment was laid out in a Randomized Complete Block Design with nine treatments replicated thrice. The treatment comprised of sole fodder maize, fodder maize-based intercropping with different legumes (cowpea, horsegram, local fieldbean and guar) in 3:1 and 2:1 row ratio.The field was ploughed once with tractor drawn cultivator followed by two times harrowing with disc. Recommended dose of FYM at 7.5 t $ha^{-1}$was applied and mixed in to the soil ten days prior to sowing. The land was smoothened with wooden plank to prepare a fine seed bed. Healthy and well matured bold seeds of Fodder maize, Cowpea, Horse gram, Field bean and Guar were selected. Sowing was done in furrows opened to a depth of 5 cm. The fodder maize and different intercropping legumes were sown at30 × 10 cm spacing with the row ratio of 3:1 and 2:1 in replacement series as per the requirement of different treatments. Nitrogen, phosphorous and potassium was applied as per the recommendations at 100:50:25 kg NPK ha^{-1} for fodder maize and 25:50:25 kg NPK ha^{-1} for different legumes through urea, single super phosphate (SSP) and muriate of potash (MOP). For fodder maize entire quantity of phosphorous and potassium was applied as basal whereas nitrogen was applied in two equal splits, one at the time of sowing and another at 30 days after sowing, for legume entire dose of fertilizer applied as basal dose. Maize and legumes are harvested at 60 DAS. The border rows were harvested first and crop from the net plot area was harvested with sickle separately for recording green fodder yield. The samples were labelled properly and kept for air dry to estimate the dry fodder weight of the crop. For recording various biometric observations, sample consisting of five plants were chosen at random and tagged in each net plot. Observation on growth parameter were recorded at 20, 40 and 60 DAS for fodder maize. The same plants were also used for recording dry matter accumulation of crop. For destructive sampling, plants were collected from 30 cm length for main crop in the destructive sampling area of the plot. To analyse the quality parameter of maize based intercropping system the plant sample are collected separately after the harvest of the crop and then oven dried at 65°C. The dried plants were powdered and were kept in the properly labelled bags and prepared samples used for analysis of different quality parameters

III. RESULTS AND DISCUSSION

Effect of intercropping system on growth and yield of fodder maize and different legumes

The experimental results show that, sole fodder maize recorded significantly higher yield (64.32 t ha^{-1}) compared to maize in intercropping system. It is mainly the plant population difference as one of the basic factors contributing towards the yield (Table-1). Optimum plant population in sole system increased the yield per unit area, as crop plants are devoid of specific competition from another crop. Hence intra competition of same species exists and it becomes mutually co-operative. On other hand, yields obtained in intercropping systems also differed significantly. The yield of fodder maize in intercropping system is also related to the per cent of area occupied in the system. In this study, fodder maize grown with legumes in 3:1 ratio recorded higher yield compared with 2:1 row ratio. Obviously the per cent proportion differed in these row ratios 75 per cent of area against 66 per cent was covered by 3:1 as compared to 2:1 row ratio. Apart from that, the inter competition by its co-intercrops also differs to give such valid difference in yield levels. The results of the finding corroborate the research work of Dadheechet al. (2005) and Kumar and Prasad (2003). Lowest yield of fodder maize was with local field bean because spreading and climbing nature of field bean reduces the resources for maize, as a matter of

competition.Different intercrops were laid in 2:1 and 3:1 row ratio with maize as main component crop. By this way for each intercrop a total space of 33 and 25 per cent to the total was provided in 2:1 and 3:1 respectively. Hence each crop exists with more population in 2:1 row ratio. As a result, intercrops tested viz., cowpea, horse gram, local field bean and guar performed better in the above said row ratio compared to 3:1. The results are in similar with the findings of Sunilkumar et al. (2005).

Crude protein of maize recorded significantly higher in fodder maize + cowpea (9.81 %) in 3:1 cropping system and lower crude protein was recorded in sole fodder maize (7.81 %). It is mainly contributed by increase in the nitrogen content in the straw. Crude fibre content of maize recorded significantly higher in sole fodder maize (35.88 %) and the lower content of crude fibre in fodder maize + cowpea (20.13 %) in 3:1 cropping system. Neutral detergent and acid detergent fibre content not varied significantly by fodder maize based intercropping system but significantly lower NDF and ADF value recorded in fodder maize (75.97 % and 57.70 %) cowpea (68.31% and 41.36 %) having 3:1 cropping system. Total ash and ether extract content was significantly higher in fodder maize + cowpea (10.25 % and 2.65% respectively,) in 2:1 and 3:1 cropping system respectively.

Treatments	Fodder maize	Intercrop	Total
T1: Fodder maize (South African Tall)	64.32	-	64.32
T2: Fodder maize + Cowpea (3:1)	56.22	19.93	76.15
T3: Fodder maize + Horse gram (3:1)	54.77	15.27	70.03
T4: Fodder maize + Guar (3:1)	53.56	14.66	68.22
T5: Fodder maize + Local field bean (3:1)	50.88	15.54	66.41
T6: Fodder maize + Cowpea(2:1)	49.05	20.36	69.41
T7: Fodder maize + Horse gram(2:1)	47.90	16.75	64.64
T8:Fodder maize + Guar (2:1)	46.02	16.74	62.76
T9: Fodder maize +Local field bean (2:1)	43.20	19.80	63.00
S.Em. ±	3.16	0.56	1.42
C.D. (P=0.05)	9.47	1.74	4.27

Table 1: Green fodder yield (t ha^{-1}) of fodder maize and legumes influenced by maize based intercropping system

Economics is the ultimate criteria for acceptance or rejection and wider adoption of any technology. The fodder maize is no exception to this. Among the different indicator of economic efficiency in production system, net return has greater impact on practical utility and acceptance of the technology by the farmers. Assessment of treatments in terms of economic traits revealed that the gross return, net return and benefit cost (B: C) ratio differed due different legume intercropping and row proportion of legumes. Higher gross return (86,115 ha^{-1}) was recorded in fodder maize + cowpea (3:1) row ratio compared to sole fodder maize (64,320 ha^{-1}). However, it is followed by fodder maize + cowpea (2:1) row ratio (79,590 ha^{-1}). Similar view also expressed by Raman kumar and Bhanumurthy (2001). Maximum net return (61,937 ha^{-1}) was recorded in fodder maize + cowpea (3:1) when compared to sole fodder maize (33,450 ha^{-1}). However, it is followed by fodder maize + cowpea (2:1) row ratio (60,130 ha-1). Higher B: C (3.08) was recorded in fodder maize + cowpea (2:1) followed by 3:1 row ratio. Lower B: C ratio (1.08) was recorded with sole fodder maize (Table-2). The higher B: C ratio might be due to higher net return. The result are in conformity with the finding of khan et al. (2002) and Kumar and Prasad (2003).

Treatments	COC (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T1: Fodder maize (South African Tall)	30869	64320	33450	1.08
T2: Fodder maize + Cowpea (3:1)	24177	86115	61937	2.52
T3: Fodder maize + Horse gram (3:1)	24002	70040	46037	1.91
T4: Fodder maize + Guar (3:1)	24252	65288	41035	1.69
T5: Fodder maize + Local field bean (3:1)	24452	66420	41967	1.71
T6: Fodder maize + Cowpea(2:1)	19459	79590	60130	3.08
T7: Fodder maize + Horse gram(2:1)	19284	64650	45365	2.35
T8:Fodder maize + Guar (2:1)	19534	59412	39877	2.04
T9: Fodder maize +Local field bean (2:1)	19734	63000	43265	2.19

Table 2: Economics (Rs. ha^{-1}) of fodder maize based intercropping system

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