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RESEARCH ARTICLE

YIELD AND ECONOMICS OF SPECLIATY CORN AT VARIOUS LEVELS OF NITROGEN APPLICATION UNDER *PONGAMIA* + MAIZE AGRI- SILVI SYSTEM

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Abstract

A field experiment was conducted during *kharif* 2011 at the Student's Farm, College of Agriculture, Rajendranagar, Hyderabad on red sandy loam soils to study the effect of nitrogen management in speciality corn under *Pongamia* + maize agri-silvi system. All the parameters such as cob yield (with husk), green fodder/stover yield, harvest index of all the types of corn were found significantly higher at 120 kg N ha^{-1} than the other two lower doses of nitrogen. Similarly kernel yield of popcorn and shelling percentage of popcorn were also found maximum at 120 kg N ha^{-1}. Maximum gross returns, net returns and B:C ratio was obtained with the combination of sweet corn at 120 kg N ha^{-1} followed by sweet corn at 90 kg N ha^{-1}.

Introduction

Arable cropping enterprise in dry lands is often unremunerative on account of aberrations in monsoon. The major constraints that limit crop production in dryland areas are moisture and nutrient stress. Conservation of soil moisture and improvement of soil fertility through addition of organic materials may improve production from these lands considerably by sustaining the soil health. Hence an integrated approach of land management to utilize the natural resources more efficiently in rainfed areas is essential to meet the requirements of farmer and his live stock without deteriorating the land productivity and also generate continuous and stable income.

One of the need based alternative land use system replacing the traditional farming system is a tree based system of cropping *i.e.,* agroforestry which acts as sustainable land management system especially in dryland areas. *Pongamia pinnata* is a multipurpose tree species (MPTS) and it is a good nitrogen fixing tree also. This tree species is sustainable under agro forestry farming system because of its fast growth and nitrogen fixation. It is the best suited tree for energy plantations. Moreover the tree prunings provide the opportunity for mulching and serve the purpose of both moisture conservation and green manuring.

Since the gestation period is high in *Pongamia* and because of wider spacing between the trees the interspaces can be effectively used for intercropping.

Maize (*Zea mays* L.) is the 3rd most important cereal in the world next to rice and wheat and has the highest production potential among the cereals. In India, the production of maize is about 15.09 M.t from an area of 7.89 M.ha, with an average productivity of 1,904 kg ha^{-1} (2009-2010) (CMIE, 2010). Of the various types of maize sweet corn, baby corn and popcorn are most important. Baby corn is nothing but maize being grown for vegetable purpose. Moreover it is a short duration crop and free from pests and diseases and its nutritive value is comparable with that of several high priced vegetables. Sweet corn is used as a human food in soft dough stage with succulent grain and 13 to 15 per cent sugar. It is gaining popularity because of its high sugar and low starch content. The other type i.e., popcorn is very popular as snack food in many parts of the world. The use of popcorn confectionaries and popcorn products especially in amusement parks, moving picture theaters etc., greatly increased the demand for popcorn products and has made a profitable outlet for those who desire to grow popcorn on a commercial scale. Hence for improved production of these corns efficient nitrogen management is needed besides sustaining soil health. Thus an integrated approach of using agroforestry and inorganic fertilizers to supplement N is promoted.

Material and Methods

The experiment was conducted at Student's Farm, College of Agriculture, Rajendranagar, Hyderabad on red sandy loam soils of Southern Telangana Agro-climatic Zone of Andhra Pradesh. The Farm is geographically situated at an altitude of 542.3 m above mean sea level at 170 19' N latitude and 780 28' E longitude. The soil of the experimental field was sandy loamy in texture(coarse sand-34.3%, sand-36.8%, silt-16.2% and clay-12.7 %), slightly alkaline in reaction (pH 7.2), Electrical conductivity (0.11 ds m^{-1}), low in organic carbon (0.52%) and nitrogen (121.4 kg ha^{-1}) and medium in available phosphorus (48.2 kg ha^{-1}) and available potassium (343.8 kg ha^{-1}). A total rainfall of 466.1 mm was received in 29 rainy days during the crop growth period. The distribution of rainfall was uniform and sufficient for better crop growth. The experiment was laid out in a randomized block design (factorial concept) with three replications. The treatments consists of three nitrogen levels (60, 90 and 120 kg N ha^{-1}) and three types of corn (baby corn, sweet corn and popcorn) as intercrops in *Pongamia* and one control treatment (sole *Pongamia* without maize and with no nitrogen). The entire quantity of P_2O_5 (i.e., 60 kg ha^{-1}) and K_2O (i.e., 40 kg ha^{-1}) was applied as basal at the time of sowing and N was applied in three splits, as basal, at knee-high and tasseling stages. The test varieties under study were **"**VL Baby Corn1", "Win Orange Sweet Corn" and "Amber popcorn". The spacings adopted were 50 cm x 15 cm in baby corn and 60 x 25 cm in both sweet corn and popcorn.

Results and Discussion

Cob yield (with husk) of speciality corn tended to increase with increased levels of nitrogen from 60 to 120 kg N ha^{-1} (Table 2.) with significant disparity between any two successive levels. The maximum cob yield was recorded with 120 kg N ha^{-1}, while the minimum cob yield was with 60 kg N ha^{-1}. The higher cob yield at higher level of nitrogen supply was mainly due to more number of cobs $plant^{-1}$ and length of the cob coupled with higher cob weight. Adequate nitrogen nutrition has promoted growth stature as well as the enhanced yield structure of speciality corn, resulting in higher cob yield. The present investigation confirms the documented evidence of Kar *et al.* (2006), Muniswamy *et al.* (2007), Suryavanshi *et al.* (2008) and Ashok Kumar (2009). Supply of nitrogen level 120 kg ha^{-1} (Table 1.) resulted in significantly higher green fodder/stover yield than the rest of the two nitrogen levels tried which were on par with each other. The maximum green fodder/stover yield with the nitrogen level of 120kg ha^{-1} could be attributed to the better vegetative growth, which in turn enhanced dry matter production. Significantly lower green fodder/stover yield was obtained with 60kg N ha^{-1}. These results are in accordance with those of Bindhani *et al.*, (2007) and Ashok kumar (2009). The increase in the level of nitrogen from 60 to 120 kg ha^{-1} also progressively increased the kernel yield of popcorn (Table.3). These results are in conformity with those of Ashok kumar (2009). Likewise, Increasing levels of nitrogen supply progressively enhanced the harvest index of speciality corn to the maximum level of nitrogen tried. Application of nitrogen at 120 kg ha^{-1} (Table 1.) recorded significantly higher harvest index than with rest of the nitrogen levels tried. The minimum harvest index was recorded with nitrogen level of 60 kg ha^{-1}

All the three types of corn were significantly different from each other with respect to all parameters such as cob yield, green fodder/ stover yield and harvest index. This variation among the types of corns might be due to their genetic differences among themselves and due to the variations in their potentialities for different growth and yield characteristics. Genotypic differences in yield are in conformity with the findings of Huseyin *et al.* (2003) and Ashok (2006).

The interaction effect between types of corn and levels of nitrogen in case of cob yield (with husk) indicated that baby corn gave significantly higher cob yield under the application of 120 kg N ha^{-1} (Table 2.) over remaining two lower doses of nitrogen. Sweet corn & popcorn also recorded higher cob yields at 120 kg N ha^{-1} which were significantly superior to both 60 kg and 90 kg N ha^{-1}. The results suggest that in speciality corn (three types), application of 120 kg N ha^{-1} is required to achieve maximum cob yield.

Economics

The gross returns (Rs. ha^{-1}) increased considerably with increased levels of nitrogen from 60 to 120 kg N ha^{-1} (Table 4.) in all the types of corn. Among the treatments, gross returns were maximum in T_3 (baby corn at 120 kg N ha^{-1}) followed T_2 (baby corn at 90 kg N ha^{-1}). Minimum gross returns were recorded in T_7 (popcorn at 60 kg N ha^{-1}) . Higher gross returns in T_3 can be attributed mainly due to higher green cob as well as green fodder yields at higher level of nitrogen application. Similar results were also reported by Bindhani *et al.* (2007).

The net returns (Rs. ha^{-1}) also increased with increased levels of nitrogen from 60 to 120 kg N ha^{-1} (Table 4.) in all the types of corn. Maximum net returns were recorded in T_3 (baby corn at 120 kg N ha^{-1}) followed T_2 (baby corn at 90 kg N ha^{-1}) . Whereas, Minimum gross returns were obtained in T_7 (popcorn at 60 kg N ha^{-1}). This was mainly due to higher cob yield obtained under higher nitrogen nutrition. These results are in accordance with those of Bindhani *et al.* (2007).

The maximum B:C ratio was obtained with the combination of baby corn at 120 kg N ha^{-1} (Table 4.) followed by baby corn at 90 kg N ha^{-1}. Minimum B:C ratio was recorded in T_7 (popcorn at 60 kg N ha^{-1}) . Similar results were also reported by Bindhani *et al.* (2007) and Ashok Kumar (2008).

Table.1. Influence of nitrogen levels on cob yield, fodder/stover yield and harvest index of specialty corn.

Treatments	**Cob yield (with husk) (kg ha^{-1})**	**Green fodder/stover yield (kg ha^{-1})**	**Harvest index (%)**
Nitrogen levels (kg ha^{-1})			
60	4294	7082	36.0
90	4852	7487	37.5
120	5366	8082	38.7
S.Em±	70.3	157.3	0.64
CD (P =0.05)	210.9	471.7	1.92
Types of corn			
Baby corn	4109	10817	26.9
Sweet corn	7010	8453	44.6
Popcorn	3393	3380	40.6
S.Em±	70.3	157.3	0.64
CD (P= 0.05)	210.9	471.7	1.92
N x T Interaction			
S.Em±	121.8	272.5	1.11
CD (P= 0.05)	365.4	NS	NS

Table 2. Cob yield (with husk) (kg ha^{-1}) of speciality corn as influenced by varying nitrogen levels and types of corn and their interaction.

Nitrogen levels (kg ha^{-1})	Types of corn			
	Baby corn	Sweet corn	Popcorn	Mean
60	3387.5	6381.8	3114.1	**4294.4**
90	4264.5	7093.0	3200.2	**4852.5**
120	4675.5	7557.2	3867.1	**5366.6**
Mean	**4109.1**	**7010.6**	**3393.8**	
	S.Em±		CD (p = 0.05)	
Nitrogen levels (kg ha^{-1})	70.37		210.99	
Types of corn	70.37		210.99	
N x C	121.88		365.45	

Table 3. Kernel yield (kg ha^{-1}) and Shelling percentage of popcorn as influenced by varying nitrogen levels

Treatment	**Kernel yield (kg ha^{-1})**	**Shelling percentage**
60	1994.9	39.7
90	2268.2	40.2
120	2656.3	40.9

*Data not analysed statististically

Table 4. Gross and Net returns (Rs ha^{-1}) and Benefit cost ratio of the system as influenced by nitrogen levels and types of corn.

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B: C ratio
T_1- *Pongamia* + Baby corn with N@ 60kg ha^{-1}	23158	62720	39562	1.70
T_2- *Pongamia* + Baby corn with N@90kg ha^{-1}	23549	75763	52214	2.21
T_3- *Pongamia* + Baby corn with N@120kg ha^{-1}	23941	84139	60198	2.51
T_4- *Pongamia* + Sweet corn with N@60kg ha^{-1}	21718	75503	53785	2.47
T_5- *Pongamia* + Sweet corn with N@90kg ha^{-1}	22109	83108	60999	2.75
T_6- *Pongamia* + Sweet corn with N@120kg ha^{-1}	22501	87418	64917	2.88
T_7- *Pongamia* + Pop corn with N@60kg ha^{-1}	22678	59845	37167	1.63
T_8- *Pongamia* + Pop corn with N@90kg ha^{-1}	23069	68920	45851	1.98
T_9- *Pongamia* + Pop corn with N@120kg ha^{-1}	23461	74551	51090	2.17
T_{10}- Sole *Pongamia* without maize and nitrogen	4500	10858	6358	1.41

Conclusion

Overall, present findings clearly showed that sweet corn with nutrient supplementation of 120-60-40 kg N, P_2O_5 & K_2O respectively was found to be most profitable intercrop in *Pongamia* plantations in sandy loam soils at Rajendranagar, Hyderabad.

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