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Productivity and economics of castor through integrated nutrient management practices under irrigated condition

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Abstract : Field experiments were carried out at Agricultural College and Research institute, Madurai during summer (Feb-June) and rainy (Aug-Dec) seasons of 2004 to study the effect of integrated nutrient management practices on yield components and oil quality of castor. Among the organic nutrients, application of FYM @ 12.5 t ha^{-1} *Azospirillum* + Phosphobacteria recorded significantly more number of spikes per plant, capsules per spike and seed yield as compared to pressmud @ 2 t ha^{-1}+ *Azospirillum* + Phosphobacteria and sugarcane biocompost @ 1 t ha^{-1}. Similarly the highest number of spikes per plant, capsules per spike, and seed yield were recorded in application of 22.5:11.5:11.5 kg NPK ha^{-1} + Zn SO_4 @ 12.5 kg ha^{-1} as basal + $ZnSO_4$ 0.25% foliar spray twice at 30 and 45 DAS as compared to other inorganic nutrients. The similar organic and inorganic nutrient treatments proved to be more economical in view of its higher net returns and benefit: cost ratio in both the seasons of summer and rainy, respectively.

Key words: Castor, FYM, pressmud, sugarcane biocompost, NPK, $ZnSO_4$.

Introduction

Castor is one of the important non-edible oilseed and industrial crops of India and has prestigious place in Indian sub continent from time immemorial. India occupies a premier position in the area, production and productivity of castor where 7.1 lakh ha was put to castor cultivation with a production and productivity of 8.5 lakh tones and 1197 kg ha^{-1}, which is very low because castor is grown in marginal lands under rainfed conditions (Nagabhushanam and Raghavaiah, 2005). In Tamil Nadu the castor crop is grown over an area of 38.9 thousand hectares, with a production of 12.7 thousand tonnes and an average yield of 326 kg ha^{-1} (Hegde, 2000).As a consequence, the area might be increased for increasing production under pure crop with irrigated condition, since the existing castor crop is cultivated as a border or bund or catch crop and that too mostly in rainfed condition under marginal and sub marginal lands with local varieties. Hence there is no scope for horizontal expansion of cultivable area, production cannot be achieved through area expansion but only through enhanced productivity by adopting proper agronomic management. The productivity of castor depends on the source and amount of nutrient supply under which it is cultivated. Although soil supplies some amount of nutrients (native nutrients), it is imperative to meet the requirements by way of supplying optimum level of nutrients through external sources in the form of organics and inorganics. These applied nutrients play an important role for higher crop production and better oil quality (Jauhri, 1998). Hence, the present study was

undertaken with a view to improve castor productivity under irrigated condition through integrated nutrient management practices

Materials and Methods

Field experiments were conducted at Agricultural College and Research Institute, Madurai to find out the effect of integrated nutrient management practices on yield characters, yield, economics and quality parameters of castor during summer (Feb-June) and rainy (Aug-Dec) seasons of 2004. The experimental site is characterized by tropical climate with mean annual rainfall of 914 mm. The soil of the experimental field was sandy clay loam (pH 8.0), having organic carbon (0.40 per cent), low in available N (228 kg ha^{-1}), medium in available P (17 kg ha^{-1}) and high in available K (280 kg ha^{-1}). The experiment was laid out in split plot design with three replications. The treatments included three organic sources of nutrients *viz.*, pressmud @ 2 t ha^{-1} + *Azospirillum* + Phosphobacteria, sugarcane biocompost @ 1 t ha^{-1} + *Azospirillum* + Phosphobacteria, FYM @ 12.5 t ha^{-1} + *Azospirillum* + Phosphobacteria and control as main treatments and inorganic source of nutrients comprised of NPK @ 30:15:15 kg ha^{-1}, NPK @ 22.5:11.5:11.5 kg ha^{-1}, NPK @ 22.5:11.5:11.5 kg ha^{-1} + Zn SO_4 @ 25 kg ha^{-1} as basal, NPK @ 22.5:11.5:11.5 kg ha^{-1} + Zn SO_4 0.5% foliar spray at 30 DAS and NPK @ 22.5:11.5:11.5 kg ha^{-1} + Zn SO_4 @ 12.5 kg ha^{-1} as basal + Zn SO_4 0.25% foliar spray twice at 30 and 45 DAS as sub treatments. The sources of chemical fertilizers for N, P_2O_5 and K_2O were in the form of Urea (46% N), Super phosphate (16% P_2O_5) and Muriate of potash (60 % K_2O), respectively. The recommended dose of fertilizer was 30:15:15 kg NPK ha^{-1}. Half dose of N, entire dose P_2O_5 and K_2O were applied as basal and the remaining half dose of N was top dressed at 60 DAS. Application of biofertilizers like *Azospirillum* and Phosphobacteria @ 2 kg ha^{-1} each was mixed with 50 kg fine sand as per the treatment. The castor variety TMV 5 was used and the seeds were sown at 60 cm apart with a plant spacing of 30 cm. The yield characters, economic yield, quality parameters and economics were studied.

Results and Discussion

Yield characters

The application of organic and inorganic sources of nutrients had significantly influenced the length of primary spike, number of spikes per plant and capsules per spike (Table 1). In general, the yield components like length of primary spike, number of spikes per plant and capsules per spike were found more in summer than rainy season, 2004. Application of FYM @ 12.5 t ha^{-1} + *Azospirillum* + Phosphobacteria recorded more number of spikes per plant and capsules per spike but hundred seed weight remained unaffected. It was followed by pressmud @ 2 t ha^{-1} + *Azospirillum* + Phosphobacteria and was comparable with sugarcane biocompost @ 1 t ha^{-1} + *Azospirillum* + Phosphobacteria. The yield was influenced by varying levels of nutrients, the effect being expressed in terms of yield components like number of spikes per plant, total number of capsules per spike and test weight as stated by Subba Reddy *et al.* (1993) and Raghavaiah and Sudhakarbabu (2000). The beneficial effect of FYM with biofertilizers might be due to continuous increased supply of micro and macronutrients and had better uptake of nutrients coupled with better accumulation and translocation of assimilates from stem and leaves to castor spikes. The yield components were increased due to application of NPK @ 22.5:11.5:11.5 kg ha^{-1} + $ZnSO_4$ 0.5% foliar spray at 30

DAS (S_4) and NPK @ 22.5:11.5:11.5 kg ha^{-1} + $ZnSO_4$ @ 12.5 kg ha^{-1} as basal + $ZnSO_4$ 0.25% foliar spray twice at 30 and 45 DAS. This might be attributed to the synergistic effect of inorganic nutrients with Zinc sulphate could have positive response in castor that might have contributed to increase in growth parameters reflected in increasing yield attributing characters (Singaravel *et al.,* 2002).

Economic yield

The application of FYM with biofertilizers produced higher seed yield compared to other organic sources (Table 2). The increase in seed yield was 33.4 to 36.1 per cent over no organic source of nutrient application. The increased growth parameters and growth indices favoured the yield components like spike number and capsules per plant, which in turn contributed to produce more seed yield with application of FYM with biofertilizers. Similar findings were also confirmed by Monib *et al.* (1984) and Subba Reddy *et al.* (1999). Economic yield of a crop depends on various contributing factors with suitable agronomic manipulation. Hence, any agronomic practice to be implemented for raising a successful crop is depended on nutrient management. In the present study, application of NPK @ 22.5:11.5:11.5 kg ha^{-1} + $ZnSO_4$ @ 12.5 kg ha^{-1} as basal + $ZnSO_4$ 0.25% foliar spray twice at 30 and 45 DAS helped to make better availability and translocation of applied nutrients from source to sink in a greater extent and produced more seed yield of 8 to 11 percent over NPK @ 30:15:15 kg ha^{-1} application in both seasons. The increased yield achieved in this promising treatment was a combined effect of applied major nutrients with zinc sulphates as soil and foliar application, which aided in better growth parameters. The favourable effect of growth parameters greatly influenced the yield components and ultimately to increase the seed yield. Similar results were reported by Mathukia and Modhwadia (1993) and DOR (1994). The increased oil yield in FYM with biofertilizer treatment and in the inorganic nutrients application of 22.5:11.5:11.5 kg NPK with $ZnSO_4$ applied as soil and foliar spray twice might be due to higher seed yield obtained in this treatment. The lower value of yield components was observed in the application of 22.5:11.5:11.5 kg NPK alone. This might be due to lower nutrient availability in soil resulted in lesser uptake of nutrients by crop, which reflected in poor seed yield.

Economics

The higher BC ratio was obtained during summer than in rainy season. The maximum net return and BC ratio were recorded in application of FYM with biofertilizer. Application of FYM + biofertilizer fetched higher returns (Rs. 5,503 to 7,884 ha^{-1}) and BC ratio (1.58 to 1.81) by virtue of higher seed yield obtained. The profound influence of organic source of nutrients resulting in better crop growth and yield might be the reason for increasing the BC ratio under FYM + biofertilizer over no organic nutrient application. The increased BC ratio under FYM with biofertilizer was due to increase in crop yield. The application of 22.5:11.5:11.5 kg NPK ha^{-1} + $ZnSO_4$ @ 12.5 kg ha^{-1} as basal + $ZnSO_4$ 0.25% foliar spray twice at 30 and 45 DAS recorded more net return which reflected in higher BC ratio. The increased seed yield obtained in the above combination could help to increase net return and higher BC ratio.

Quality parameters

The organic and inorganic sources of nutrients application did not exert any significant influence on oleic and linoleic acid content

(Table 2). Similar findings on quality was reported by several earlier researchers (Raghaviah, 1999; Khadke and Riazuddin Ahmed, 2000). In oil seeds, the synthesis of oil in the seeds is a function of genetic make up of a genotype and is not much altered by any management practices. In the present study also, nutrient management has not exerted any influence on oil content. Similarly there was no significant difference in ricinoleic acid and linoleic acid due to the application of organic and inorganic sources of nutrients.

It can be concluded from the present study that getting higher productivity and more profitable of castor under irrigated condition, the promising INM practice of FYM @ 12.5 t ha^{-1} + *Azospirillum* + Phosphobacteria coupled with NPK @ 22.5:11.5:11.5 kg ha^{-1} + $ZnSO_4$ @ 12.5 kg ha^{-1} as basal application + $ZnSO_4$ @ 0.25% foliar spray twice at 30 and 45 DAS could be recommended.

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