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Effect of different levels of nitrogen and potassium on mechanised rice

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Abstract
A field experiment was conducted during *Kharif* 2016 at ZAHRS, Brahmavar Udupi district to study the Nitrogen and Potassium management for mechanized rice cultivation in the coastal zone of Karnataka. Experiment was laid out in Randomized block design with three replication. Total ten treatments were used to an evaluation of different growth and yield parameters. Treatments include combination of three levels each of nitrogen and potassium (60, 75 and 90 Kg ha^{-1} each of N and K). Among different treatment results revealed that the highest grain (5900 kg ha^{-1}) and straw yield (7567 kg ha^{-1}) was recorded with the application of 90:30:60 kg NPK ha^{-1} as compared to RDF (60:30:60 kg NPK ha^{-1}, standard check) followed by the application of 90:30:75 kg NPK ha^{-1} and lower grain (2683 kg ha^{-1}) and straw yield (3933 kg ha^{-1}) was recorded with the application of RDF apart from the absolute control.

Keywords: Mechanised rice, nitrogen, potassium, nutrient uptake in rice

Introduction
Assuring the food security for more than half of the population in India, rice contributes to 20-25 per cent of agriculture in India. In rice, the most common method of planting is manual transplanting which is quite labour intensive operation, during the peak period of farm operations, labour scarcity coupled with higher wages lead to delay in transplanting and other farm operations. Apart from that, optimum plant to plant and row to row spacing was not achieved due to decreased efficiency of labour over the time. It has been observed that the plant population planted by the contract labour is very low and it a causes decrease in yield which in turn leads to indenting alternate methods. Among them, transplanters have gained significance among farmers because of easy adoptability and higher yield than conventional method (Vineetha *et al.*, 2016) [7].

Apart from saving in time and cost of transplanting which is very high in manual transplanting, mechanized transplanting remove human drudgery and can give uniform and desired plant density. Moreover, one can plant the crop in line at no extra cost and make weeding and intercultural operation easier. Though attempts have been made in different countries to develop a mechanical paddy transplanter, so far transplanters have been manufactured and successfully introduced only in a few countries like Japan, Korea and China etc. With the introduction of paddy transplanter in Japan, the labour requirement for transplanting has been reduced from 30 man days to 15 man days per ha (Anoop Dixit *et. al.*, 2007) [1].

Nitrogen and potassium are considered as the quality and quantity limiting factor for paddy. Nitrogen is the key element of rice production which improves potassium and phosphorous utilization to an appreciable extent. The influence of nitrogen is more pronounced and this nutrient interacts in increasing the grain yields of rice. Apart from promoting vegetative growth, it also helps in increasing crop yield and protein content in grains. Whereas potassium is one of the three major nutrients which has received the least attention through an application of rice. Potassium performs important roles in enzyme activation, photosynthesis, photosynthates translocation, protein synthesis (i.e., nitrogen use) and plant water relations and is known to play an important role in the plant's ability to resist disease. The rate and time of fertilizer N and K application varies with location, climate, input availability and genetic potential of rice varieties.

Particularly, a study on nitrogen and potassium management in mechanically transplanted rice is very meager. Therefore, the field experiment was carried out to fill this knowledge gap and to showcase the production potential of mechanically transplanted rice in pursuit to develop sustainable and labour saving technologies of rice production.

Material & Methods

A field experiment was conducted during *kharif* season of 2016 at Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi district, Karnataka. Soil type is sandy loam in texture and pH was acidic (5.04). The soil was medium in available nitrogen (316 kg ha^{-1}), high in available phosphorus (55.23 kg ha^{-1}) and medium in available potassium (152.12 kg ha^{-1}). The organic carbon content was high (1.18%) in range. MO-4 (Red rice) a popular medium duration variety was transplanted in July using four row transplanter. Experiment included ten treatments consisted of T_1 : 60:30:60 NPK kg ha^{-1} (check), T_2 : 60:30:75 NPK kg ha^{-1}, T_3 : 60:30:90 NPK kg ha^{-1}, T_4 : 75:30:60 NPK kg ha^{-1}, T_5 : 75:30:75 NPK kg ha^{-1}, T_6 : 75:30:90 NPK kg ha^{-1}, T_7 : 90:30:60 NPK kg ha^{-1}, T_8 : 90:30:75 NPK kg ha^{-1}, T_9 : 90:30:90 NPK kg ha^{-1}, T_{10}: 0:0:0 NPK kg ha^{-1}, were laid out in Randomized Complete Block Design (RCBD) with three replications. Growth parameters and yield (biological and economical) was recorded from individual plots at harvest and converted to kg/ha. Composite soil sample was used to assess soil nutrient status. Plant samples were collected and analyzed for nutrient content at harvest. Standard statistical methods were used for comparing the treatment means.

Results & Discussion

Table 1: Effect of different nitrogen and Potassium levels on yield and N, P and K uptake of mechanised rice

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
T_1 : 60:30:60 NPK kg ha^{-1} (check)	4383	5833	119.57	22.61	94.89
T_2 : 60:30:75 NPK kg ha^{-1}	4567	6267	124.68	25.82	107.44
T_3 : 60:30:90 NPK kg ha^{-1}	4477	6067	120.10	24.04	103.70
T_4 : 75:30:60 NPK kg ha^{-1}	4750	6383	125.43	27.00	110.01
T_5 : 75:30:75 NPK kg ha^{-1}	5127	6633	127.86	29.09	113.44
T_6 : 75:30:90 NPK kg ha^{-1}	5217	6900	130.20	29.97	116.42
T_7 : 90:30:60 NPK kg ha^{-1}	5900	7567	136.83	36.94	128.44
T_8 : 90:30:75 NPK kg ha^{-1}	5778	7388	134.21	34.18	125.01
T_9 : 90:30:90 NPK kg ha^{-1}	5515	7154	132.93	31.35	121.73
T_{10}: 0:0:0 NPK kg ha^{-1}	2683	3933	66.87	18.85	84.55
SEm±	339.23	542.81	9.61	1.87	7.42
CD (0.05)	1007.9	1612.8	28.58	5.57	22.06

Significantly higher grain and straw yield (5900 and 7567 kg ha^{-1}, respectively) in the application of 90:30:60 NPK kg ha^{-1} followed by application of 90:30:75 NPK kg ha^{-1} recorded 5778 and 7388 kg ha^{-1}, grain and straw yield. This is due to maintenance of uniform and optimum spacing between row to row and plant to plant and also during hand transplanting, the root washed seedlings were shocked before establishment in the puddled soil while in mat seedling, the roots carry some soil within the root-net and seedlings being mechanically detached in clusters from the mat had more uniform placement in the puddled soil (Jagvir Dixit and Khan, 2011) [3]. The increased dry matter production in case of application of 90:30:60 NPK kg ha^{-1} might be due to obvious reasons of better availability of nutrients, water and energy resulting in opportunity for greater root growth, increased availability and accessibility of nutrients as reported by Duraisamy *et al.* (2011) [2] and Sannagoudar *et al.* (2012) [4].

Significantly higher uptake of N, P and K (136.83, 36.94 and 128.44 kg ha^{-1}) were observed with the application of 90:30:60 NPK kg ha^{-1} which was at par with the application of 90:30:75 NPK kg ha^{-1}. Increased levels of nitrogen and potassium have shown the significant increase in nutrient accumulation which could be attributed to increased nitrogen supply as well as better growth and activity of nutrients. Increased uptake of nitrogen may be due to the split application which has resulted in the quick availability of nitrogen. Also increased nitrogen application led to increased grain yield which suggests that any increase in nitrogen absorption by the roots eventually increases its assimilation in grains. Further addition of potassium to 90:30:60 NPK kg ha^{-1} did not show any response which is due to the fact that specific effect of potassium is observed through the increased efficiency if nitrogen utilization (Thakuria and Choudary, 1995) [5]. But there was no significant difference between the different levels of potassium with 90 kg nitrogen ha^{-1}. This can be attributed to the interaction effect of NH_4^+ and K^+ ions in the soil was positive and better at the application of 90:30:60 kg NPK ha^{-1}. Similar findings were observed by Upperi, 1981 [6].

Conclusion

On the basis of experiment, it can be concluded that the application of 90:30:60 NPK kg ha^{-1} had significantly increased in the grain yield, straw yield and NPK uptake followed by the application of 90:30:75 NPK kg ha^{-1} due to optimum spacing and also optimum utilisation of nutrients by rice crop under Brahmavar Udupi district of Karnataka.

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