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EFFECT OF NITROGEN SPLITS ON GROWTH, YIELD AND ECONOMICS OF TRANSPLANTED RICE VARIETIES

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ABSTRACT

A field experiment was conducted at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C. G.) during *kharif* season of 2023. The experiment was laid out in split plot design with three replications. The treatment composed of three splitting of nitrogen in main plots N_1- 40% (B) + 30% (T) + 30% (PI), N_2 - 50% (B) + 25% (T) + 25% (PI) and N_3 – 30% (B) + 30% (T) + 30% (PI) + 10% (F) and four different varieties (V_1- Vikram TCR, V_2 – CG Devbhog, V_3 – Rajeshwari and V_4 -Protezin in sub-plots. The data revealed that significantly higher plant height (102.01 cm), number of effective tillers hill^{-1} (12.20), grain yield (5.69 t ha^{-1}), straw yield (6.19 t ha^{-1}), harvest index (47.40%), net returns (Rs.79040 ha^{-1}) and benefit cost ratio (2.74) was recorded with nitrogen splitting of 30% (B) + 30% (T) + 30% (PI) + 10% (F). Among varieties, Vikram TCR produced higher plant height (102.11 cm), number of effective tillers hill^{-1} (12.31), grain yield (6.19 t ha^{-1}), straw yield (6.76 t ha^{-1}), harvest index (47.58%), net returns (Rs.89993 ha^{-1}) and benefit cost ratio (2.99) whereas test weight (31.02 g) was recorded with variety Rajeshwari.

***Keywords*:** Nitrogen splits, transplanted rice, varieties, growth, yield, economic.

Introduction

The state of Chhattisgarh is referred to as the "Rice Bowl of India" since it contributes more than 23,250 accessions of rice, including 210 wild species. The largest rice grown area is the *kharif* season. With an average annual rainfall of 1200–1300 mm, the state is dependent on the monsoon. Rice is mostly grown in a rainfed habitat in the state. In Chhattisgarh rice occupies average of 3.6-million-hectare area with the productivity ranging between 1.2 to 1.6 tonnes per hectare depending upon the rainfall (Jaiswal *et al.*, 2022).

Nitrogen application play important role and directly contributes in enhancing yield of rice which are being given in different rate in different agro-ecosystem. Optimum utilization of used fertilizers depends on quantity, time of application and crop growth stage. One of the main factors limiting rice productivity was discovered to be the timing of nitrogen treatment. Nitrogen influences rice yield by playing major role in the photosynthesis, biomass accumulation, effective tillering and spikelet formation (Yoshida *et* al., 2006). Use of adequate N rate is important not only for obtaining maximum economic return, but also to reduce environmental pollution.

Materials and Methods

An experiment was conducted at Research cum instructional farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C. G.) during *kharif s*eason of 2023. To determine the splitting of nitrogen effect on growth, yield and qualities of transplanted rice varieties. The plot was ploughed and prepared by using tractor drawn cultivators and leveler. The soil was clay classified as *vertisol*. It was low in nitrogen (137.90 kg ha^{-1}) medium in phosphorus (13.81 kg ha^{-1}) and in potassium (309.56 kg ha^{1}), normal pH (7.21), EC (0.58 dSm^{1}) and organic carbon (0.40%). Four weeks old seedlings, were transplanted at 20 cm x 10 cm spacing. Two to three seedlings were planted per hill. The water level was maintained at 2 to 5 cm throughout the vegetative growth and reproductive stages. Pests and diseases were controlled whenever necessary. Weeds were controlled by hand weeding.

The treatments comprised of three splits of nitrogen under main plot – *i.e.* N_1-40% (Basal)+ 30% (Tillering) + 30% (Panicle initiation), N_2 - 50% (Basal)+ 25% (Tillering) + 25% (Panicle initiation) and N_3 – 30% (Basal) + 30% (Tillering) + 30 % (Panicle initiation) + 10% (Flowering)and four different varieties under subplot- *i.e.* V_1- Vikram TCR, V_2 – CG Devbhog, V_3 – Rajeshwari and V_4 -Protezin. The experiment was conducted using split plot design with three replications. General fertilizer recommendation of 80, 60 and 40 N, P_2O_5 and K_2O kg ha^{-1} was followed. Phosphorus as single superphosphate and potash as muriate of potash were applied as basal. Nitrogen as urea was splittedas per the treatments. Data on plant height, number of effective tillers, test weight, grain yield, straw yield and harvest index were recorded from net plot. The experimental data recorded on various parameters were analyzed statistically by following the analysis of variance procedure given by Gomez and Gomez (1984). Critical difference for examining treatment means for their significance was calculated at 5% level of probability.

All the growth, yield and economic parameters were recorded using standard procedures. Plant height was measured at harvest from ground level to the tip of the panicle from randomly selected plants and averaged. Number of effective tillers $hill^{-1}$ was counted as productive tillers bearing panicles. Test weight was determined by weighing 1000 grains. Grain and straw yield were recorded from net plot area after harvesting and drying. Harvest index was calculated as the ratio of grain yield to total biological yield. Economic parameters such as cost of cultivation, net returns and benefit cost ratio were computed using standard methods.

Results and Discussion

Growth and yield

Plant height (cm) and number of effective tillers $hill^{-1}$ were observed at harvest and the data are presented in table 1. Significant variation was found in plant height and number of effective tillers $hill^{-1}$due to different nitrogen splitting on varieties. Higher plant height (102.01 cm) and number of effective tillers $hill^{-1}$ (12.20) were recorded with splitting of30% N at basal + 30 % N at tillering + 30% N at panicle initiation + 10% at flowering at harvest which was statistically at par with 40% N at basal +30 % N at tillering + 30% N at panicle initiation at harvest. The minimum plant height at harvest (98.11 cm) and number of effective tillers $hill^{-1}$ (10.12) were recorded with split application of 50% N at basal + 25% N at tillering + 25% N at panicle initiation. Islam *et al.* (2009) reported that availability of nitrogen throughout the growth stages might be responsible for the better performance. Jashim *et al.* (1984) reported that this might be due to split application of N has a positive influence on the production of effective tillers, respectively. Among varieties, higher plant height (102.11 cm) and number of effective tillers $hill^{-1}$ (12.31) were recorded with variety Vikram TCR at harvest which was statistically at par with variety CG Devbhog at harvest. The minimum plant height (97.89 cm) and number of effective tillers $hill^{-1}$ (9.83) were recorded with variety Protezin. Genetic factor could be responsible for plant height differences among varieties. Jahan *et al.* (2014) reported that variation occurs from variety to variety. Chaudhury *et al.* (1993) reported that this variation in the production of effective tillers $hill^{-1}$ might be due to genetic makeup of the varieties, respectively.

Test weight showed non-significant variation due to different nitrogen splitting and data are presented in table 1. However, it was affected due to different rice varieties. Higher test weight (31.02g) was recorded with variety Rajeshwari and minimum test weight (19.17g) with variety CG Devbhog. Setiawati *et al.* (2020) recorded different test weight due to varietal difference.

Grain yield (t ha^{-1}), straw yield and harvest index showed significant variation due to different nitrogen splitting and varieties and data are presented in table1. Maximum grain yield (5.69 t ha^{-1}), straw yield (6.19 t ha^{-1}) and harvest index (47.40 %) were recorded with splitting of 30% N at basal + 30 % N at tillering + 30% N at panicle initiation + 10% at flowering which was statistically at par with 40% N at basal + 30 % N at tillering + 30% N at panicle initiation. The minimum grain yield (5.57 t ha^{-1}), straw yield (5.79 t ha^{-1}) and harvest index (45.33%) were recorded with 50% N at basal + 25% N at tillering + 25% N at panicle initiation. This result might be due to effective utilization of N at critical stages of crop resulting in better vegetative growth and production of more productive tillers, panicle weight and panicle length, which ultimately led to higher grain yield. Similar result was also reported by Singh & Singh (2005), Sathiya & Rajesh (2009), Hafeez *et al.* (2013) and Amrutha *etal.* (2016), This might be due to better growth reflected in these treatments in terms of plant height, dry matter accumulation and tillering. These results are in findings of Yogeshwar Singh *et al.* (2006) and Zayed *et al.* (2011) and This might be due to better translocation of assimilates from source to sink as was observed with number of filled grains panicle^{-1}. Similar result was also reported by Ombir Singh *et al.* (2012) and Sunita Gaind and Lata Main (2012), respectively. In case of varieties, higher grain yield (6.19 t ha^{-1}), straw yield (6.76 t ha^{-1}) and harvest index (47.58%) were recorded with variety Vikram TCR and minimum grain yield (4.82 t ha^{-1}), straw yield (5.34 t ha^{-1}) and harvest index (45.22%) with variety Protezin. Variety Vikram TCR and CG Devbhog were performs similar in terms of straw yield and harvest index. The variable straw yield of the rice varieties might be due to difference in their count of tillers hill^{-1}. Similar result was also reported by Vaishnav *et al.* (2022).

Economics

The data on cost of cultivation are presented in table 2. Highest cost of cultivation (Rs.45389 ha^{-1}) was recorded with splitting of 30% N at basal + 30 % N at tillering + 30% N at panicle initiation + 10% at flowering. In case of varieties, highest cost of cultivation was recorded with CG Devbhog (Rs.45428ha^{-1}). Minimum cost of cultivation (Rs. 45098 ha^{1}) was recorded with variety Rajeshwari.

The data on net returns and benefit cost ratio are presented in table 2. Significant variation was found due to nitrogen splitting and varieties. Highest net returns (Rs.79094 ha^{-1}) and benefit cost ratio (2.74) were recorded with splitting of 30% N at basal + 30 % N at tillering + 30% N at panicle initiation + 10% at flowering which was at par with 40% N at basal + 30 % N at tillering + 30% N at panicle initiation due to benefit cost ratio. The minimum net returns (Rs. 73638 ha^{-1}) and benefit cost ratio (2.62) were recorded with 50% N at basal + 25% N at tillering + 25% N at panicle initiation. In case of varieties, highest net returns (Rs. 89993 ha^{-1}) and benefit cost ratio (2.99) were recorded with variety Vikram TCR. Minimum net returns (Rs. 60110 ha^{-1}) and benefit cost ratio (2.32) was recorded with variety Protezin. Application of nitrogen in splits according to group requirement caused not only decrease in the loss of N but also increased the N absorption and better utilization of applied nitrogen leads to higher yield attributes and finally resulted in higher grain yield and this may be the reason for higher gross return, net return and b: c ratio. This was in accordance with finding of Balasubramanium *et al.* (2002), Singh and Thakur (2007) and Nair *et al.* (2000).

Conclusions

On the basis of results summarized above, it can be concluded that splitting of nitrogen 30% N at basal + 30 % N at tillering + 30% N at panicle initiation + 10% at flowering gave promising results of respect to all the crop growth, yield and economics. Among varieties, Vikram TCR produced higher crop growth, yield attributes, yield and economics.

Table 1 : Effect of nitrogen splits on growth, yield attributes, yield and economics of transplanted rice varieties.

Treatment	Plant height at harvest (cm)	Number of effective tillers	Test weight (g)	Grain yield (t ha^{-1})	straw yield (t ha^{-1})	Harvest index (%)	Cost of cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Benefit cost ratio
Nitrogen splits									
N_1–40% (B)+30 %(T)+ 30%(PI)	100.31	11.06	24.93	5.60	5.94	47.02	45189	77094	2.70
N_2 – 50%(B)+ 25 %(T) +25 %(PI)	98.11	10.12	23.41	5.47	5.79	45.33	45189	73638	2.62
N_3-30% (B)+30%(T)+30%(PI)+10%(F)	102.01	12.20	25.62	5.69	6.19	47.40	45389	79040	2.74
SEm±	**0.69**	**0.39**	**0.53**	**0.05**	**0.07**	**0.41**			**0.02**
CD (P= 0.05)	**2.7**	**1.54**	**NS**	**0.18**	**0.29**	**1.60**			**0.08**
Varieties									
V_1 – Vikram TCR	102.11	12.31	21.20	6.19	6.76	47.58	45248	89993	2.99
V_2 – CG Devbhog	101.37	11.91	19.17	5.68	5.96	47.15	45428	78631	2.73
V_3 – Rajeshwari (R_1)	99.22	10.37	31.02	5.62	5.83	46.39	45098	77627	2.72
V_4–Protezin	97.89	9.83	27.22	4.82	5.34	45.22	45248	60110	2.32
SEm ±	**0.94**	**0.63**	**0.27**	**0.14**	**0.28**	**0.40**			**0.07**
CD (P= 0.05)	**2.82**	**1.90**	**0.81**	**0.42**	**0.84**	**1.17**			**0.20**

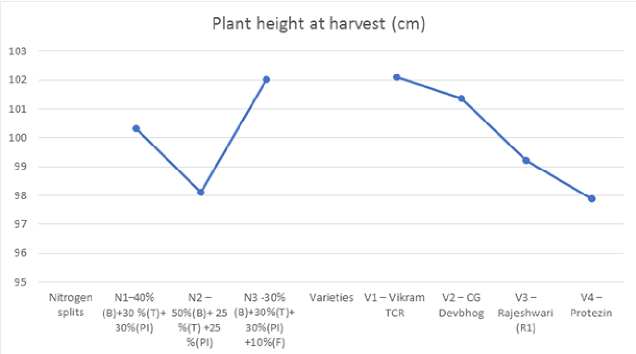

Fig. 1. : Effect of nitrogen splits on plant height of rice varieties

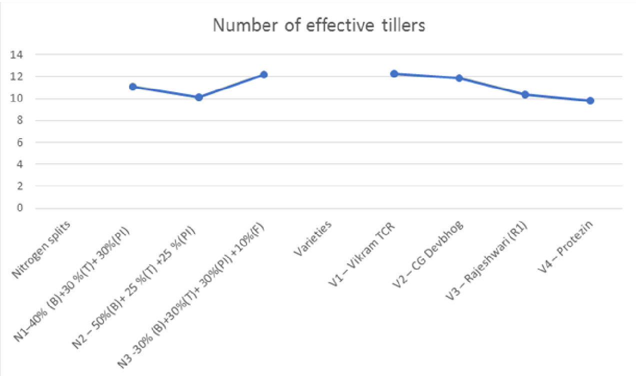

Fig. 2 : Effect of nitrogen splits on number of effective tillers of rice varieties

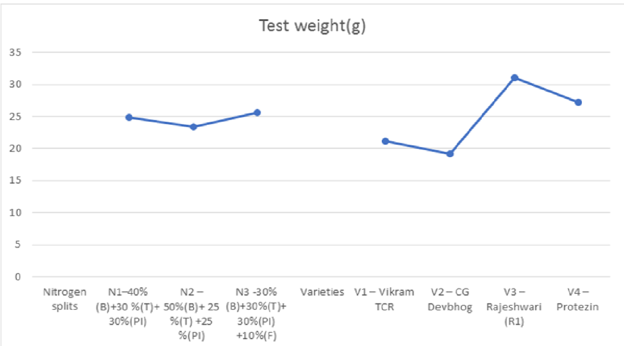

Fig. 3 : Effect of nitrogen splits on test weight of rice varieties

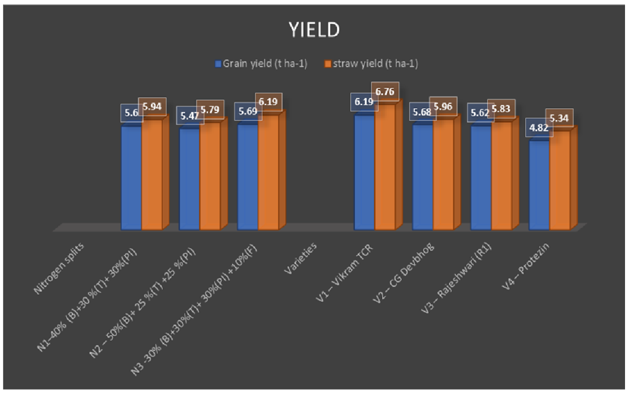

Fig. 4 : Effect of nitrogen splits on grain and straw yield of rice varieties

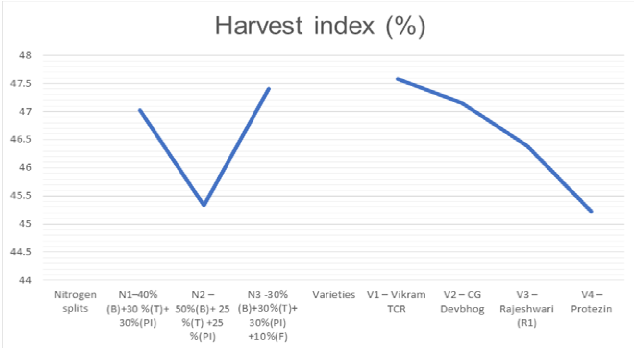

Fig. 5 : Effect of nitrogen splits on harvest index of rice varieties

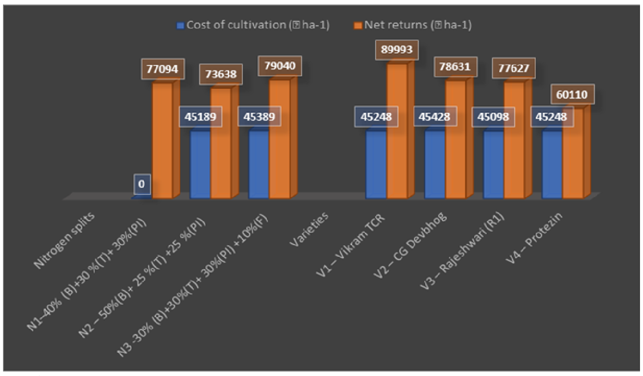

Fig. 6 : Effect of nitrogen splits on cost of cultivation and net returns of rice varieties

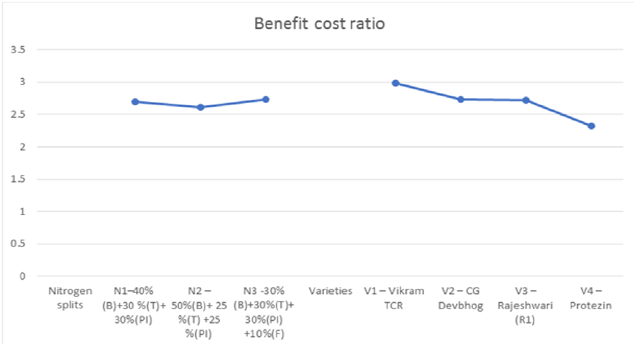

Fig. 7 : Effect of nitrogen splits on benefit cost ratio of rice varieties

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