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PHYSIOLOGICAL REGULATION OF DRY MATTER PARTITIONING AND NITROGEN USE EFFICIENCY IN RICE (*Oryza sativa* L.) VARIETIES UNDER DIFFERENTIAL NITROGEN APPLICATION

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ABSTRACT

An investigation was carried out during *kharif-2019* and *kharif-2020* to study the response of rice varieties on dry matter partitioning and harvest index under four nitrogen levels (0, 120, 240 and 360 kg N ha^{-1}) as main treatments and three varieties viz. BPT5204, NDLR-7 and NLR 34449 as sub treatments at various growth stages (Tillering stage, Panicle initiation stage, Flowering stage and Harvest stage). Among the nitrogen level root dry matter was numerically higher during tillering, panicle initiation, and flowering stage at higher rates of N application *i.e.*, 240 kg N ha^{-1} and 360 kg N ha^{-1}. However, at harvest N application at the rate of 120 kg N ha^{-1} recorded highest dry weight of compared to higher doses of N application. Culm dry matter is higher at higher doses of N application *i.e.*, 240 kg N ha^{-1} and 360 kg N ha^{-1} at all growth stages. Among the three varieties NDLR-7 (V_2) recorded numerically higher dry matter partitioning to root (3.85 g) and leaf (3.56 g) compared to BPT 5204 (V_1) and NLR 34449 (V_3). Pooled data on interaction effects at harvest also revealed that higher dry matter partitioning to root, leaf and grains was recorded in NLDR-7 and NLR 34449 in response to 120 kg N per ha^{-1} application followed by 360 kg N ha^{-1}and NLR 34449 at the rate of 360 kg N ha^{-1}. We concluded rice variety NDLR 7 with N application of 120 kg Nha^{-1} is beneficial in partitioning dry matter among plant parts *viz*., root, leaf culm and resulted in higher harvest index. Higher doses of N could only contribute dry matter to culm and remobilization of photosynthates to grain is very poor. Hence application of the intermediate level of nitrogen was economical and environment-friendly.
***Keywords* :** dry matter partitioning efficiency, harvest index, nitrogen level, rice.

Introduction

Rice is one of the most important cereal crops of the world which feeds half of the world's population providing 35-60% of the total calorie (Tayefe *et al.*, 2014). During past few decades, rice production increased mostly due to adoption of high yielding varieties, increase in irrigated area and use of chemical fertilizers. However, the rate of increase in rice yield is static and if the rate is not possible to increase, severe food shortage is likely to occur in near future. To push up the yield ceiling, sustainable technologies are essential, which are economically viable, environmentally friendly, low-cost technologies and cost minimization by saving resources must be considered in rice production. Among the crop management practices, judicious application of nitrogenous fertilizer is paramount important for yield enhancement of rice.

Nitrogen (N) is the most limiting nutrient for rice crop growth and yield which is required in higher amounts compared to other nutrients (Djaman *et al.*, 2018). N influences rice yield by playing major role in the photosynthesis, biomass accumulation, effective tillering, and spikelets formation (Yoshida *et al.*, 2006). Therefore, N fertilization is imperative for modern rice varieties to exploit their full yield potential

(Chamely *et al.*, 2015). High yielding modern rice varieties show a greater response to applied nitrogen, while they differ in N demand depending on their genotype and agronomic traits under different climatic conditions (Rahman *et al.,* 2007). On the other hand, excessive N application can lead to ground water pollution, increased production cost, reduced yield and environmental pollution (Djaman *et al.,* 2018).

Therefore, it is essential to achieve efficient use of nitrogen in chemical fertilizers, through cultivation techniques and fertilizer management with high nitrogen use efficiency and reducing nitrogen inputs from farming to the environment. Evaluating the reaction of rice to diverse doses of nitrogen will aid in the development of high nitrogen use efficiency varieties, and the screening of appropriate genotypes for all cultivated condition. Numerous studies have investigated varietal variation in yield and Nitrogen use efficiency. However, measuring genotypic differences in dry matter production and nitrogen use efficiency at the vegetative growth stage eliminates those additional variables affecting yield. One important approach is to develop an understanding of the plant response to different nitrogen regimes and studying plants that show better growth under nitrogen limiting conditions. Studies on impacts of elevated nitrogen on growth dynamics, biomass partitioning, chaffy grain and nitrogen use efficiency are limited.

Hence, the objective of this study was to investigate varietal differences in response to elevated doses of nitrogen fertilizer among 3 rice varieties to provide essential information for the breeding of varieties that are suitable for cultivation with less application and reduced dose of N fertilizer for eco-friendly sustainable agriculture.

Materials and Methods

A field experiment was conducted during the *kharif*-2019 and *kharif*-2020 at college farm, agricultural college, Mahanandi, ANGRAU, Guntur. The experiment was laid out in a split plot design with four nitrogen levels *i.e.* 0 (Control), 120 kg N ha^{-1}, 240 kg N ha^{-1} 360 kg N ha^{-1} and three varieties viz BPT 5204 (V_1), NDLR-7 (V_2) and NLR34449 (V_3) as sub treatments and the experiment was replicated thrice. The rice varieties were sown separately in raises bed nursery thirty-day old seedlings were transplanted in to 12 m^2 (4m x 3m) plot by adopting a spacing 20 cm between rows and 15cm between plants with in row. Nitrogen was applied as per the treatments 120 kg N ha^{-1}, 240 kg N ha^{-1} and 360 kg N ha^{-1} in three equal splits in the form of urea. Depending on the nitrogen treatment one third dose of nitrogen was applied as basal dose at the time of planting of the crop. Remaining two equal splits of nitrogen was broadcasted at maximum tillering and panicle initiation stages.

Data recording and handling Data

DM accumulation and partitioning at tillering, flowering and physiological maturity stages, and HI. At each growth stage, five hills (plants) within each treatment were harvested. Leaves, culms, and root were separated, dried in paper bags, and weighed by an electronic balance, and then average data (g/hill) on dry weights of leaf, culm and root were calculated. Total dry matter (TDM) was calculated as sum of the dry weights of the plant components. At harvest maturity each treatment of rice crop was harvested, and the material was sun-dried up to a constant weight, weighed and then converted into biological yield (biomass) (kg/m^2). The harvested material for biomass yield was threshed. The grains were separated and weighed, and then converted into grain yield (kg/m^2). HI was calculated according to the following formula: Harvest index (%) = Grain yield / Biological yield × 100.

Statistical analysis

The data was analyzed statistically following the method given by Panse and Sukhatme (1987) and wherever the results were significant the critical difference (CD) was calculated at 5 per cent level of significance (P=0.05).

Results and Discussion

Dry matter partitioning in to culms

At tillering stage, the culm dry matter was significantly affected by the N levels and interaction. The highest dry matter partitioning (0.64g) was produced with 120 kg N h^{-1} while the lowest DMP 0.53g was observed in 240 kg N ha^{-1} being at par with N control plots. Among the rice varieties the NDLR 7 produced the maximum dry matter partitioning (0.56 g) followed by NLR34449 (0.56 g) while the minimum DMP (0.5 g) was produced by BPT 5204. Interactions of N x V indicated that application of N at 120 kg N ha^{-1} increased the dry matter partitioning in NDLR 7 and reduced the dry matter partitioning in other two varieties.

At panicle initiation stage, the culm dry matter partitioning was significantly affected by the N levels and genotypes. The maximum dry matter partitioning (2.70 g) was produced with 240 kg N h^{-1} while the lowest dry matter partitioning (2.19 g) was observed in 360 kg N ha^{-1}. Among the rice varieties the BPT 5204 produced the maximum dry matter partitioning (2.55 g) followed by NLR34449 (2.35 g) while the minimum DMP (0.5 g) was produced by NDLR 7. Interactions of N x V indicated that application of N at 240 kg N ha^{-1} increased the dry matter partitioning in NLR 3449 and significantly minimum dry matter partitioning was observed in NDLR 7 with the application of 360 kg N^{-1}.

At flowering stage, the culm dry matter partitioning was affected by the N levels and genotypes. The maximum dry matter partitioning (7.59 g) was produced with 240 kg N h^{-1} while the lowest dry matter partitioning (6.79 g) was observed in 120 kg N ha^{-1}. Among the rice varieties the NDLR 7 produced the maximum dry matter partitioning (7.67 g) followed by NLR34449 (7.38 g) while the minimum DMP (6.56 g) was produced by BPT 5205. Interactions of N x V indicated that application of N at 240 kg N ha^{-1} increased the dry matter partitioning in culms of NDLR 7 and significantly minimum dry matter partitioning was observed in NLR3449 with the application of 120 kg N^{-1}.

At harvest stage, the maximum dry matter partitioning (7.36 g) was produced with 360 kg N h^{-1} while the lowest dry matter partitioning (6.45 g) was observed in 240 kg N ha^{-1}. Among the rice varieties the NLR 34449 produced the maximum dry matter partitioning (7.25 g) followed by NDLR 7 (6.96 g) while the minimum DMP (6.76 g) was produced by BPT 5205. Interactions of N x V indicated that application of N at 360 kg N ha^{-1} increased the dry matter partitioning in culms of NLR 34449 and significantly minimum dry matter partitioning was observed in BPT 5204 with the application of 360 kg N^{-1}.

Dry matter partitioning in to leaves

At tillering stage, the leaf dry matter partitioning was affected by the N levels and genotypes. The maximum dry matter partitioning (1.02 g) was produced with 120 kg N ha^{-1} while the lowest dry matter partitioning (0.83 g) was observed in control plots. Among the rice varieties the NDLR 7 produced the maximum dry matter partitioning (1.08 g) followed by NLR 34449 (0.92 g) while the minimum DMP (0.79 g) was produced by BPT 5205. Interactions of N x V indicated that increase in the N level from 120 to 360 kg N ha^{-1} increased the leaf dry matter partitioning efficiency. Interaction among the N x V indicated that highest leaf dry matter partitioning efficiency of NDLR 7 was observed with 120 kg N ha^{-1}. Among the interactions significantly the lowest leaf dry matter partitioning efficiency was recorded in BPT 5204 with 360 kg N ha^{-1}.

At panicle initiation stage, the leaf dry matter partitioning was affected by the N levels and genotypes. The maximum leaf dry matter partitioning efficiency (2.06 g) was produced with 120 kg N h^{-1} while the lowest dry matter partitioning (0.57 g) was observed with 360 kg N^{-1}. Among the rice varieties the NDLR 7 produced the maximum leaf dry matter partitioning (1.86 g) followed by BPT 5204 (1.83 g) while the minimum LDMPE (1.63 g) was produced by NLR 34449. Interactions of N x V indicated that increase in the N level from 120 to 360 kg N ha^{-1} increased the leaf dry matter partitioning efficiency. Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NDLR 7 with 120 kg N ha^{-1} (N_2V_2) being at par with N_2V_1, N_3V_3, N_3V_2. Significantly the lowest leaf dry matter partitioning efficiency was observed in NLR34449 with control followed by NLR 34449 with 120 kg N ha^{-1}.

At flowering stage, the leaf dry matter partitioning was affected by the N levels and genotypes. The maximum leaf dry matter partitioning efficiency (3.56 g) was produced with 240 kg N h^{-1} while the lowest leaf dry matter partitioning efficiency (2.90 g) was observed with control plots. Among the rice varieties the NDLR 7 produced the maximum leaf dry matter partitioning efficiency (3.81 g) followed by BPT 5204 (3.21 g) while the minimum LDMPE (2.63 g) was produced by NLR 34449.

Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NDLR 7 with 240 kg N ha^{-1} (N_3V_2) being at par in BPT 5204 with 360 kg N ha^{-1} (N_4V_1), in NDLR 7 with 120 kg N ha-1 (N_2V_2). Significantly the lowest leaf dry matter partitioning efficiency was observed in NLR34449 with 360 kg N ha^{-1} followed by NLR 34449 with control plots.

At harvest stage, the leaf dry matter partitioning efficiency (LDMPE) was affected by the N levels and genotypes. The maximum leaf dry matter partitioning efficiency (4.19 g) was produced with 120 kg N h^{-1} while the lowest leaf dry matter partitioning efficiency (2.37 g) was observed with control plots. Among the rice varieties the NDLR 7 statistically produced the maximum leaf dry matter partitioning efficiency (3.56 g) followed by BPT 5204 (3.38 g) while the minimum LDMPE (2.85 g) was produced by NLR 34449.

Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NLR 34449 with 360 kg N ha^{-1} (N_4V_3) being at par in NLR 34449 with 120 kg N ha^{-1} (N_2V_3) and in NDLR 7 with 120 kg N ha^{-1} (N_2V_2). The lowest leaf dry matter partitioning efficiency was observed in NLR34449 with control plots.

Dry matter partitioning efficiency in root

At tillering stage, the root dry matter partitioning efficiency (RDMPE) was affected by the N levels and genotypes. The maximum root dry matter partitioning efficiency (2.42 g) was produced with 360 kg N h^{-1} while the lowest root dry matter partitioning efficiency (1.22 g) was observed with control plots. Among the rice varieties the NDLR 7 statistically produced the maximum root dry matter partitioning efficiency (1.86 g) followed by NLR 34449 (1.52 g) while the minimum RDMPE (1.44 g) was produced by BPT 5204.

Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NLR 34449 with 360 kg N ha^{-1} (N_4V_3) being at par in NDLR 7 with 3600 kg N ha^{-1} (N_4V_2) and in BPT 5204 with 360 kg N ha^{-1} (N_4V_1). Significantly the lowest root dry matter partitioning efficiency was observed in BPT 5204 and NDLR 7 with control plots.

At panicle initiation stage, the root dry matter partitioning efficiency (RDMPE) was affected by the N levels and genotypes. The maximum root dry matter partitioning efficiency (1.67 g) was produced with 360 kg N ha^{-1} while the lowest root dry matter partitioning efficiency (1.52 g) was observed with 240 kg N ha^{-1}. Among the rice varieties the BPT 5204 statistically produced the maximum root dry matter partitioning efficiency (1.61 g) followed by NDLR 7 (1.58 g) while the minimum RDMPE (1.54 g) was produced by NLR 34449.

Among the different interactions of N x V maximum root dry matter partitioning efficiency was observed in rice variety BPT 5204 with 360 kg N ha^{-1} (N_4V_1) being at par in NDLR 7 with 120 kg N ha^{-1} (N_2V_2) and in BPT 5204 with 240 kg N ha^{-1} (N_4V_1). The lowest root dry matter partitioning efficiency was observed in BPT 5204 with control plots.

At flowering stage, the root dry matter partitioning efficiency (RDMPE) was affected by the N levels and genotypes. The maximum root dry matter partitioning efficiency (3.90 g) was produced with 240 kg N h^{-1} while the lowest root dry matter partitioning efficiency (2.37 g) was observed with control plots. Among the rice varieties the NDLR 7 statistically produced the maximum root dry matter partitioning efficiency (3.03 g) followed by BPT 5204 (2.69 g) while the minimum RDMPE (2.64 g) was produced by NLR 34449.

Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NLR 34449 with 240 kg N ha^{-1} (N_3V_3) being at par in NDLR 7 with 240 kg N ha^{-1} (N_3V_2) and in BPT 5204 with 240 kg N ha^{-1} (N_3V_1). The lowest root dry matter partitioning efficiency was observed in BPT 5204 with 120 kg N ha^{-1}.

At harvest stage, the root dry matter partitioning efficiency (RDMPE) was affected by the N levels and genotypes. The maximum root dry matter partitioning efficiency (4.72 g) was produced with 120 kg N h^{-1} while the lowest root dry matter partitioning efficiency (2.25 g) was observed with 240 kg N ha^{-1}. Among the rice varieties the NDLR 7 statistically produced the maximum root dry matter partitioning efficiency (3.85 g) followed by NLR 34449 (3.79 g) while the minimum RDMPE (2.48 g) was produced by BPT 5204.

Among the different interactions of N x V the maximum leaf dry matter partitioning efficiency was observed in rice variety NDLR 7 with 120 kg N ha^{-1} (N_2V_2) being at par in NDLR 7 with 240 kg N ha^{-1} (N_3V_2) and in BPT 5204 with 240 kg N ha^{-1} (N_3V_1). The lowest root dry matter partitioning efficiency was observed in BPT 5204 with 120 kg N ha^{-1}.

Harvest Index

Harvest index significantly affected by nitrogen levels and varieties. Among the N levels the maximum HI (41.53 %) was calculated for 120 kg N ha-1 being at par with 240 kg N ha^{-1} (37.73 %), while the minimum HI (33.81%) was achieved in 360 kg N ha^{-1}. Among the rice varieties the maximum HI (40.09 %) was recorded for NLR 34449, followed by NDLR 7 (39.52 %), while the minimum HI was calculated for BPT 5204.

Interaction effects of N application rates and varieties are significant and revealed that highest harvest index was recorded in NDLR 7(44.6) and NRL 3449 (42.0) in response to 120 kg N per ha^{-1}application followed by NDLR 7 (39.7) in response to 240 kg N ha^{-1}. The lowest harvest index was recorded in BPT 5204 (23.5) in response to 360 kg N ha^{-1}

Discussion

In this study, significant variability in dry matter partitioning into leaf, root and culm was observed among nitrogen levels, three rice varieties and their interaction in all growth stages *i.e.,* tillering stage, panicle initiation stage and harvest stage. However, the differences among the values are only numerical. Dry matter partitioning in different varieties of paddy under varying nitrogen (N) levels significantly influences growth, yield, and overall productivity. Dry matter accumulation reflects growth and metabolic efficiency of a plant, which ultimately influences the economic yield. The biomass accumulation is having significant influence on grain yield of rice. Accumulation of dry matter, along with its effective partitioning to economically important plant parts, holds the key for yield stability. Dry matter distribution is the product of anabolic flow from supply organs (leaves and stems) on the way to storage organs (grains).

Among the nitrogen level root dry matter was numerically higher during tillering, panicle initiation and flowering stage at higher rates of N application *i.e.,* 240 kg N ha^{-1} and 360 kg N ha^{-1} however at harvest N application at the rate of 120 kg N ha^{-1} recorded highest dry weight of compared to higher doses of N application. Culm dry matter is higher at higher doses of N application *i.e.,* 240 kg N ha^{-1} and 360 kg N ha^{-1} at all growth stages.

Leaf dry matter is prime factor in cereals as it influences grain filling and final yields. Dry matter partitioning to leaf is higher under N application at all the growth stages specially at harvest. Consequently, dry matter partitioned into grain in terms of grain yield is significantly higher in N application at 120 kg N ha^{-1} compared to all other treatments. These results had positive impact on grain yield in terms of higher dry matter portioned to the leaf, which in turns maintained higher current photosynthesis and grain filling.

Dry matter partitioning to culm is higher at higher doses of N application *i.e.,* 240 kg N ha^{-1} and 360 kg N ha^{-1}. Data on LAI and LAD also revealed the similar results of higher values at N application rate of 120 kg N ha^{-1}. Paul *et. al.* (2021) conducted an experiment in fine aromatic boro rice (BRRI dhan50) with four levels of nitrogen *viz.,* 0, 50, 100 and 150 kg ha^{-1} revealed that the highest total dry matter partitioning and accumulation were obtained from 150 kg N ha^{-1} at physiological maturity.

The higher stem weight resulted from greater partitioning of assimilates to stem because when the N in root zone is more, the root to shoot ratio increases. The grain yield depends on the partitioning of dry matter into its economical portion and its conversion into grain. Optimum nitrogen levels enhance HI by ensuring efficient partitioning of dry matter to grains. Excessive nitrogen leads to more vegetative biomass, lowering HI.

Harvest index (HI) is the physiological efficiency of the plant to convert fraction of photo assimilates into grain yield. Significant variability in harvest index was observed among nitrogen levels, three varieties and their interaction at harvest stage. Nitrogen application at the rate of 120 kg N ha^{-1}(N2) reported significantly higher harvest index compared to 360 kg N ha^{-1}(N4) and numerically high harvest index compared to 240 kg N ha^{-1} (N3). Enhanced harvest index at higher nitrogen levels was reported by Zhang *et. al*. (2020) in giant rice varieties Feng 5 and Feng 6 under five doses of nitrogen fertilizers, namely, 0 kg ha^{-1} (CK), 75 kg ha^{-1} (T1), 150 kg ha^{-1} (T2), 225 kg ha^{-1} (T3) and 300 kg ha^{-1} (T4) reported that the grain yield index (HI) first increased and then decreased with the increase of nitrogen application rate.

The increase in harvest index with increasing levels of nitrogen might be due to better translocation of assimilates from source to sink as was observed with number of filled grains per panicle and 1000 grain weight. These similar results are in conformity with the findings of (Koffi Djaman *et al.,*2016 and Djaman *et al.,*2018).

Conclusion

Dry matter partitioning efficiency denotes that at higher N application (360 kg N ha^{-1}) partitioning was more into stem compared to leaves and roots. This may be the reason for more lodging was noticed at this treatment. Whereas N application rate of 120 kg N ha^{-1} and 240 kg N ha^{-1} partitioning was more into leaves and roots at flowering and harvest stage. The present study reveals that response to nitrogen application in rice crop is variety specific. For scarce rainfall zone (Experiment location) the recommendation is 240 kg N ha^{-1}, whereas the interaction data of present study reveals that N application at the rate of 120 kg N ha^{-1} to NDLR 7 recorded higher dry matter partitioning efficiency, Nitrogen use efficiency and grain yield compared to other N treatments and varieties. Hence blanket recommendation of N for all varieties need to be revised.

Future Perspectives

Further research on culm strength and lodging susceptibility at higher nitrogen application is required. Nitrogen use efficiency includes complex interactions of N uptake efficiency and N utilization efficiency. Hence to understand the intrinsic nitrogen movement across the plant parts specially into grain advanced studies using Fluorescein isothiocyanate (FITC) labelling method can be adopted.

Table 1 : Influence of different nitrogen levels on dry matter partitioning efficiency of rice (*Oryza sativa* L.) varieties at Tillering stage, Panicle initiation, flowering stage, Harvest stage and Harvest index (Pooled)

Treatments	Tillering stage			Panicle initiation			Flowering stage			Harvest stage			Harvest Index (%)
	Pooled			Pooled			Pooled			Pooled			
N application rate (N)	**Root**	**Leaf**	**Culm**	**Root**	**Leaf**	**Culm**	**Root**	**Leaf**	**Culm**	**Root**	**Leaf**	**Culm**	**Pooled**
N_1 (Control)	1.22	0.83	0.56	1.56	1.60	2.34	2.37	2.90	6.97	3.65	2.37	7.02	36.42
N_2 (120 Kg N ha^{-1})	1.30	1.02	0.64	1.57	2.06	2.28	2.43	3.16	6.79	4.72	4.19	6.84	41.53
N_3 (240 Kg N ha^{-1})	1.49	0.89	0.53	1.52	1.87	2.70	3.90	3.56	7.59	2.25	3.66	6.45	37.73
N_4 (360 Kg N ha^{-1})	2.42	0.97	0.58	1.67	1.57	2.19	2.45	3.25	7.47	2.88	2.83	7.36	33.81
S.E(m)±	**0.32**	**0.13**	**0.06**	**0.15**	**0.37**	**0.25**	**0.39**	**0.27**	**0.49**	**0.80**	**0.52**	**0.38**	**1.58**
C.D (P=0.05)	**1.11**	**0.43**	**0.21**	**0.51**	**1.27**	**0.86**	**1.36**	**0.92**	**1.71**	**2.76**	**1.78**	**1.33**	**5.48**
Varieties (V)													
V_1 (BPT 5204)	1.44	0.79	0.50	1.61	1.83	2.55	2.69	3.21	6.56	2.48	3.38	6.76	32.50
V_2 (NDLR-7)	1.86	1.08	0.67	1.58	1.86	2.23	3.03	3.81	7.67	3.85	3.56	6.96	39.52
V_3 (NLR34449)	1.52	0.92	0.56	1.54	1.63	2.36	2.64	2.63	7.38	3.79	2.85	7.25	40.09
S.E(m)±	**0.16**	**0.09**	**0.04**	**0.10**	**0.15**	**0.10**	**0.48**	**0.22**	**0.41**	**0.50**	**0.47**	**0.53**	**1.42**
C.D (P=0.05)	**0.47**	**0.26**	**0.13**	**0.31**	**0.44**	**0.29**	**1.45**	**0.65**	**1.22**	**1.51**	**1.40**	**1.59**	**4.25**
Interaction (N x V)													
N_1V_1	1.12	0.86	0.41	1.37	1.91	2.52	2.43	2.75	6.58	2.43	2.68	6.72	35.3
N_1V_2	1.17	0.89	0.66	1.68	1.57	2.28	2.44	3.45	6.62	3.35	2.34	6.65	35.2
N_1V_3	1.38	0.75	0.59	1.62	1.31	2.23	2.24	2.50	7.71	2.78	2.09	6.58	38.7
N_2V_1	1.10	0.81	0.54	1.49	2.34	2.68	2.03	2.84	6.51	2.00	3.99	6.81	38.0
N_2V_2	2.09	1.42	0.87	1.71	2.40	2.16	3.00	3.86	7.78	6.52	4.23	6.45	44.6
N_2V_3	0.72	0.83	0.51	1.50	1.43	2.01	2.26	2.78	6.07	5.62	4.34	6.25	42.0
N_3V_1	1.31	0.85	0.53	1.62	1.43	2.56	3.39	3.32	6.81	2.69	3.94	6.30	33.2
N_3V_2	1.68	0.93	0.62	1.43	2.01	2.59	4.13	4.35	8.21	2.45	2.51	6.55	39.7
N_3V_3	1.48	0.90	0.44	1.51	2.18	2.95	4.17	3.00	7.74	1.59	3.29	6.50	40.3
N_4V_1	2.23	0.63	0.50	1.96	1.63	2.43	2.91	3.91	6.32	2.80	2.91	5.22	23.5
N_4V_2	2.51	1.08	0.56	1.50	1.48	1.89	2.57	3.59	8.09	3.07	2.30	8.36	38.6
N_4V_3	2.50	1.19	0.70	1.55	1.61	2.24	1.88	2.25	8.00	5.17	4.53	8.50	39.3
Mean	**1.61**	**0.93**	**0.58**	**1.58**	**1.78**	**2.38**	**2.79**	**3.22**	**7.20**	**3.37**	**3.26**	**6.99**	**37.37**
N x V													
S.E(m)±	**0.31**	**0.17**	**0.09**	**0.20**	**0.29**	**0.19**	**0.97**	**0.43**	**0.82**	**1.01**	**0.93**	**1.06**	**2.83**
C.D (P=0.05)	**0.94**	**0.52**	**0.26**	**0.61**	**0.88**	**0.58**	**2.90**	**1.30**	**2.45**	**3.01**	**2.80**	**3.17**	**8.49**

Fig.1 Effect of different levels of N on Dry matter partitioning efficiency at Tillering stage

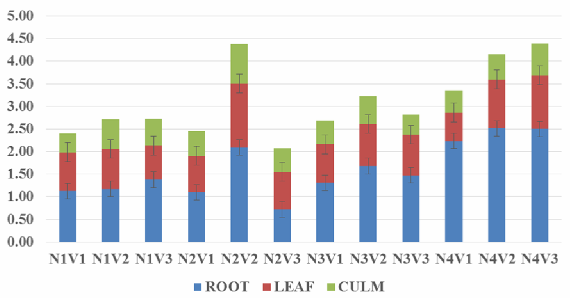


Fig.2 Effect of different levels of N on Dry matter partitioning efficiency at Panicle initition Stage

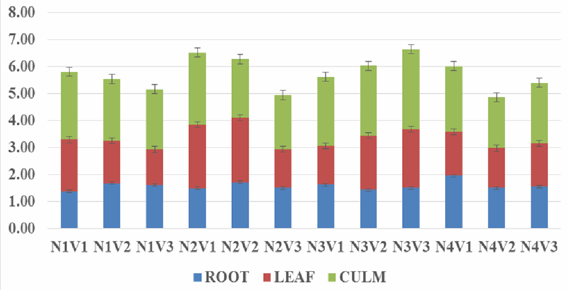


Fig.3 Effect of differtent levels on N on dry matter partiotioning efficiency at Floweringstage

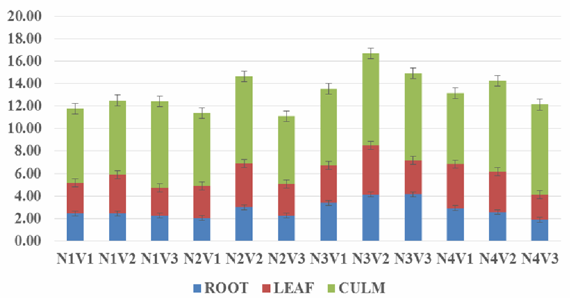


Fig. 4 Effect of different levels of N on Dry matter partitioning efficiency at Harvest stage

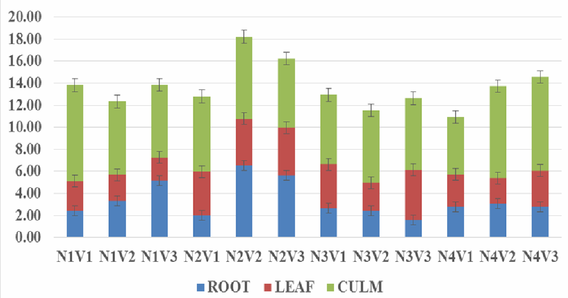


Fig. 5 : Effect of different levels of N on Dry matter partitioning efficiency at Tillering stage, panicle initiation, Flowering and harvest stage

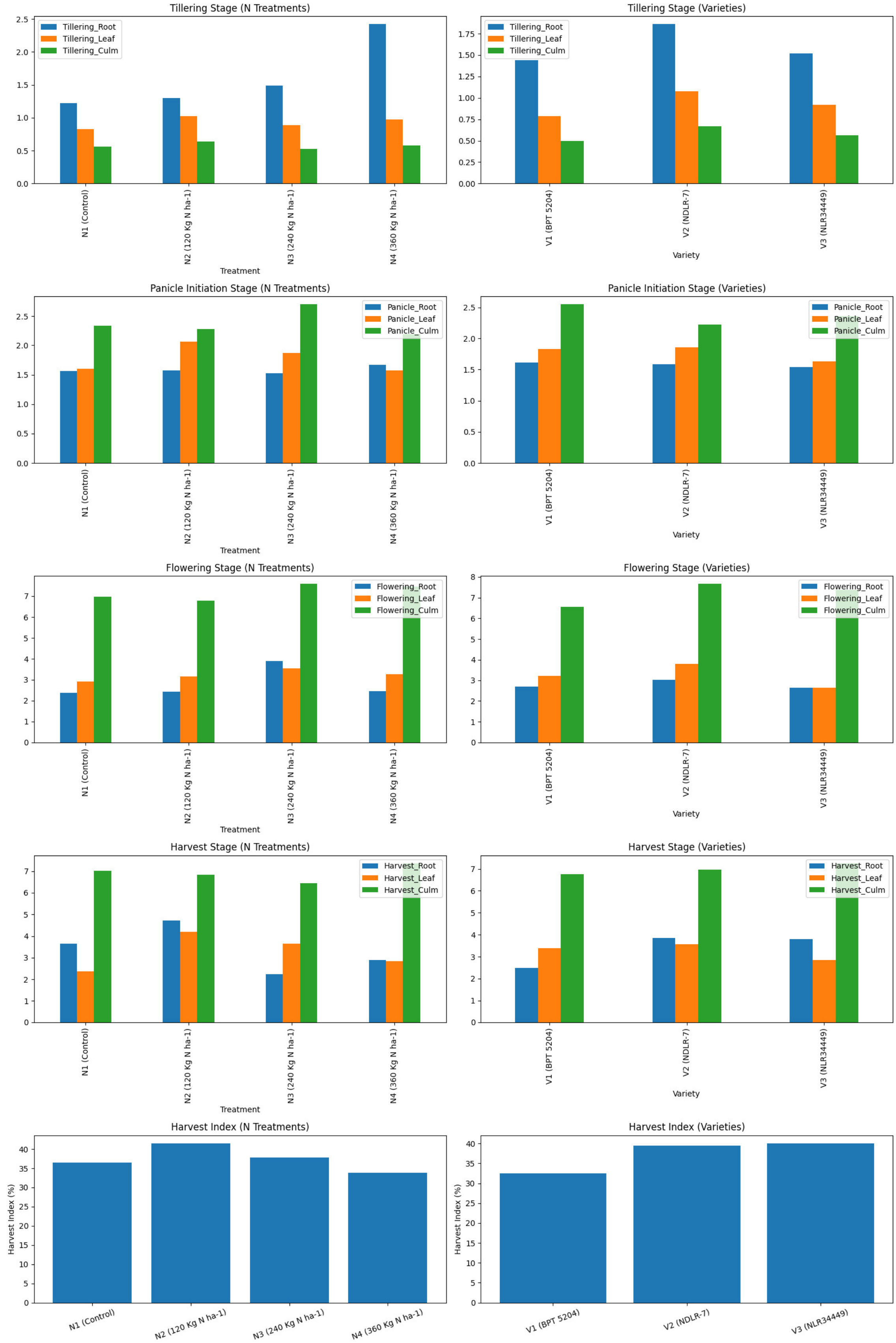
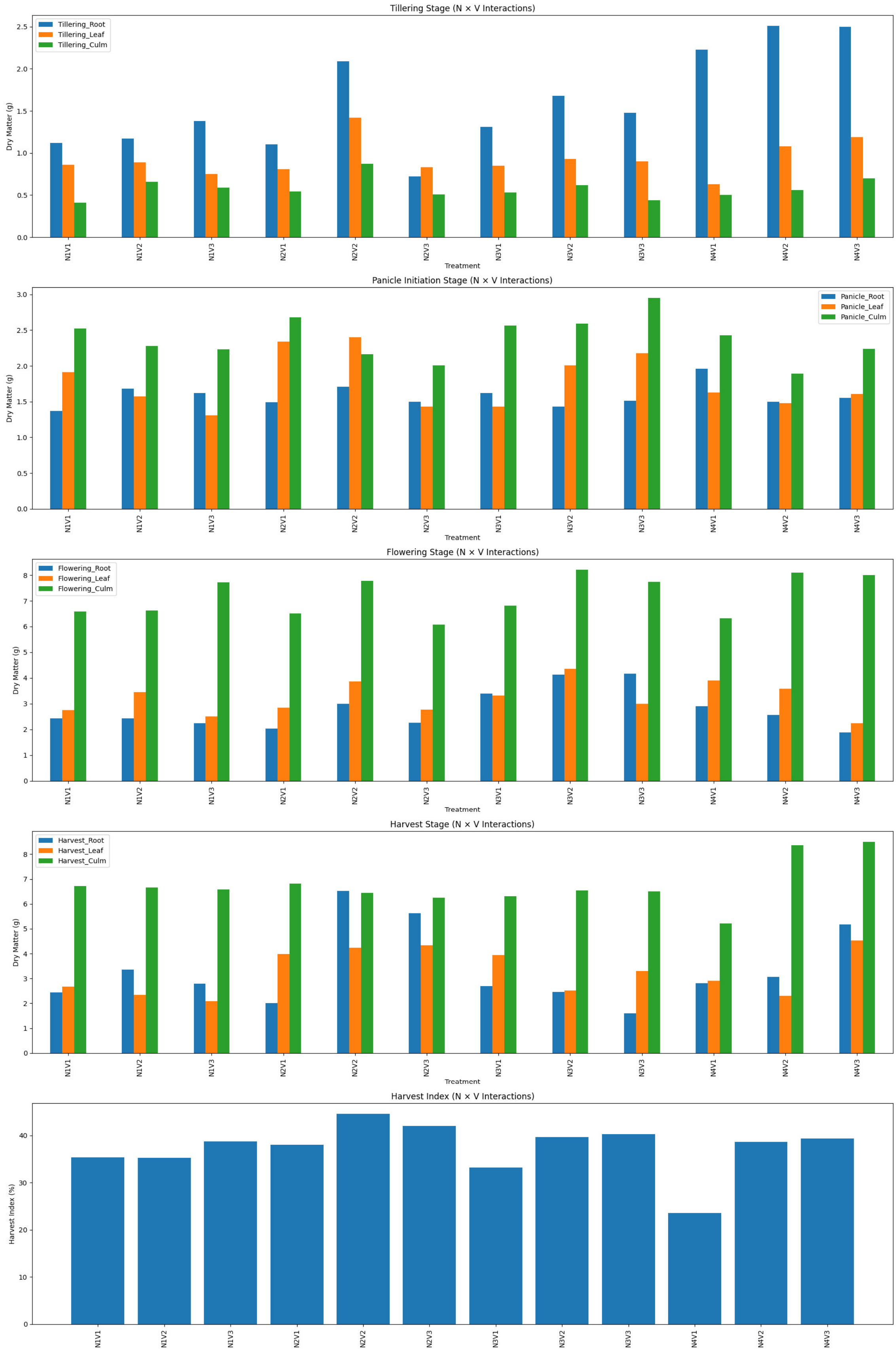


Fig. 6 : Interaction effect of different levels of N on Dry matter partitioning efficiency at Tillering stage, panicle initiation, Flowering and harvest stage



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Disclosure statement

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