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Nutrient Uptake and Drymatter Accumulation of Different Rice Varieties Grown Under Shallow Water Depth

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ABSTRACT

A field experiment was conducted at the Adaptive Research Station, Sakhigopal, Puri during kharif-2012 to study the nutrient uptake and dry matter accumulation in the newly released rice genotypes. Nine rice genotypes such as Tanmayee, Mrunalini, Tejaswini, Swarna, OR-2327-23, OR-2324-8, Pratikhya, Hiranmayee and Swarna sub-1 were taken into test under shallow water depth condition in the field in a randomised block design (RBD) in three replications The uptake of N, P and K by the shoot of the genotypes at both the stages exhibited positive association with grain yield. The uptake of N, P and K by the shoot at flowering and harvest can be utilized to forecast the grain yield of rice. The NPK uptake by the grain wasmaximum in Tanmayee (g/m^2) where as the minimum uptake of the same was recorded in Hiranmayee (g/m^2) in the study area.

Key words: *Tanmayee, Mrunalini, Tejaswini, Swarna, Kharif*

INTRODUCTION

India is one of the world's largest producers of rice next to China. In Odisha, around 93% area is covered with rice crop during Kharif season which is generally sown in June-July and harvested in November-December. In eastern India, about 10 million hectares of area is covered with the waterlogged area where the yield of rice is only 2.4 tons/ha. It meets about 31 and 17 percent of total caloriesand protein requirement respectively. Hence it is considered as astaple food of 65% of Indian population. The submerged rice ecosystem in India represents 26% of the total cultivated area. Considering the rising population growth in India the expected rice requirement must be augmented to a level of 130 million tons by 2050, Paroda[5] informed that rice production in India is almost stagnant for last six years.

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Hence, to achieve the targeted yield under reduced area, declining impact use efficiency having limited irrigation facility in the rainfed ecosystem the appropriate varieties should be used in the lowland. Among the abiotic stresses mainly water logging, light and temperature, soil salinity and drought may adversely affect plant growth and performance[2]. In Odisha flooding usually, occurs in 3 stages of plant growth and can last for 7 days to one month. The stipulation that flooding must be sustains for at least one month is to be distinguished deep water rice area from other flood prone areas. In the coastal belt, the water may rise up to more than 50 cm by tide action and the flash flood areas where rice may be temporarily submerged for only a few days. Most deep water rice survives by elongation of the stem, where as other rice type lack these characteristics and are destroyed by deepwater. The rise in water is the most important source of flooding. Monsoon rain in the water shade brings the river down in foot flood. On reaching the flat topography the flow rate slow and over bank spills of turbid silty water bring to flood the land. Prolong water logging during the rainy season for the most part of crop growth reduces tillering and growth of the normal rice crop. Erratic or early heavy rain fall results in sudden water logging in the rice field and submerges the situation occurs in an early vegetative period. In crop competition occurs in communities for nutrients so there is a need of perfect evaluation of improved rice varieties in deep water areas is one of the critical needs for sustainable rice production in deepwater logged ecology.

MATERIAL AND METHODS

A field experiment on rice was conducted during *Kharif* 2012 in the Adaptive Research Station, Sakhigopal, Puri to study the mophophysiological and biochemical characters responsible of the rice genotypes under shallow water depth condition which are related for yield of the crop. The Adaptive Research Station, Sakhigopal is situated in 19°48' North Latitude and 85°52' East Longitude and 20 kms away from Bay of Bengal with an altitude of 6m above the mean sea level. The date of sowing in the nursery bed was conducted from 7th June, 2012. The nursery bed was developed for planting of nine varieties of rice as mentioned above. Required amount of FYM and phosphatic fertilizers were well mixed with the soils of nursery for development of fertility of soil, before date of sowing. The nine varieties were sown by in lines with keeping appropriate spacing between the varieties. After 30 days of sowing the seedling was up rooted for transplanting. The mainland (50m x 40 m) was ploughed with tractor after harvest of the previous crop. Then FYM @ 5t/ha was spread over the field. Again the yield was cross-ploughed and leveled properly. Each replication was subdivided into 22 subplots for the allocation of varieties. Before transplanting of seedlings and basal dose of 25kg N, 30Kg P_2O_5 and 30 Kg K_20 per hectare were applied and mixed thoroughly in soil during piddling. Rest nitrogen was top dressed twice. The first top dressing of nitrogen @30Kg/ha in the form of Urea was applied after 15 days of transplanting. The second top dressing of nitrogen @ 25kg/ha in the form of Urea was applied at 112 days after transplanting. Thirty days old seedlings of rice genotypes were transplanted in the main field on 07.07.2012 with a spacing of 20cm x 15cm having two seedlings per hill.

The plant material for the nutrient evaluation was collected from five randomly selected plants in each replication for all the parameter at growing stage and tagged for recording a representative sample of the entire population. After harvesting, grains were collected to determine the nutrient uptake.

The nitrogen content of different plant parts at heading and grain maturity were estimated following the procedure of A.O.A.C[1].

Phosphorus and potassium present in plant sample were estimated by adopting the procedure of Jackson[3].

The uptake of particular mineral nutrient by the plant and its parts is calculated by multiplying the concentration of that nutrient with dry matter of the plant parts both at harvesting stage respectively.

RESULTS AND DISCUSSIONS

Shoot dry matter production and its partitioning into different plant parts at flowering was reflected in **(Table-1)** which indicated that Tanmayee had significantly higher shoot-DM (1057.5g/m^2) than the other genotypes. On the other hand, Swarna sub-1 had lowest value (620.4g/m^2) of the same. On the whole, the variation in shoot-DM at flowering among the genotypes followed the sequence

Tanmayee > Mrunalini > Tejaswini > OR-2327-23 > Swarna > OR-2324-8 > Pratikhya > Hiranmayee > Swarna sub-1.

In addition Tejaswini had significantly lower shoot-DM than Mrunalini (959.4g/m^2). Partitioning of shoot-DM into different plant parts of the genotypes exhibited that irrespective of the genotypes stem had more DM than leaf and panicle. Similarly leaf-DM was greater than panicle-DM in all the genotypes. As regards to percentage of dry matter contribution by the plant parts it was observed that contribution of stem-DM to shoot-DM varied from 57.41% in Tanmayee to 51.37% in Swarna sub-1. In case of leaf this variation ranged from 23.41% in Tanmayee to 23.96% in Swarna sub-1 but; the percentage of panicle-DM varied from 16.59% in Tanmayee to 24.72% in Swarna sub-1. Total shoot-DM and its partitioning into different plant parts of the genotypes at harvest was presented in **(Table-1).** Among the genotypes Tanmayee had highest shoot-DM (1652.3mg/g) whereas, the lowest value (1016.2mg/g) of the same was exhibited by Swarna sub-1. In general the variation in shoot-DM among the tested genotypes at maturity followed the same sequence as flowering. As regards to the partitioning of the shoot-DM into different plant parts of the genotypes at maturity stage exhibited the following sequence.

Panicle-DM > Stem-DM > Leaf-DM

The percentage of partitioning of shoot-DM into stem of the genotypes varied at harvest from 20.64% in Tejaswini to 37.49% in Swarna sub-1. Similarly, the variation in leaf-DM ranged from 15.13% in Swarna sub-1 to 29.82% in Tejaswini however, the percentage of panicle-DM varied from 50.60% in Tanmayee to 47.45% in Swarna sub-1. Production of biomass is basically a function of net photosynthesis per plant. Due to lower photosynthesis, the dry matter production decreases. The potential activity of photosynthesis is only expressed under favourable conditions resulting the expression of maximum genetic potential leading to higher productivity of any crop. Same biomass having two crops may differ in their yield potentiality. In selective genotypes or yield prescribing cultural practices, the agricultural scientists must have in their site enhanced yield, not only increased biomass. The physiological approach should thrust upon proper partitioning of the accumulated dry matter for yield augmentation. It is worthy to mention here that dry matter partitioning is more crucial plant productivity point of view dependant on many internal or external factors.

Shoot-DM production and its partitioning to different plant parts at flowering and harvest showed that irrespective of the genotypes, stem contributes (54.45%) followed by leaf (24.50%) to the total shoot-DM production at flowering, whereas, panicle contributes (50.73%) followed by stem (29.30%) to the total dry matter production at harvest **(Table-1)**.

Comparison of shoot-DM at the genotypes at flowering indicated that Tanmayee exhibited significantly higher shoot-DM production (1057.57g/m^2) than other varieties, whereas, Swarna sub-1 showed the lowest value (620.4g/m^2) of the same. At flowering stage the partitioning sequience was in order of stem-DM > leaf-DM > panicle-DM in all the test genotypes. Variation in shoot-DM among the genotypes at harvest revealed that Tanmayee showed maximum shoot-DM production (1652.3g/m^2) whereas, the lowest value of the same (1016.2g/m^2) was exhibited in Swarna sub-1**(Table-1)**. Partitioning of shoot-DM of different plant parts of all the genotypes at harvest showed the sequence of panicle-DM > stem-DM > leaf-DM. The percentage of partitioning of shoot-DM into

stem of genotypes varied from 20.64% in Tejaswini to 37.49% in Swarna sub-1. Similarlly, the variation in leaf-DM ranged from 15.13% in Swarna sub-1 to 29.82% in Tejaswini. However, the percentage of panicle-DM varied from 47.45% in Swarna sub-1 to 54.90% in OR-2324-8.

In the present finding, it was observed that dry matter of stem and leaf decrease from flowering to harvest in all the genotypes of rice under test under the shallow water depth condition, whereas, the panicle-DM get increased during the same period. This finding is in conformity with the findings of Saitoh et al.

Nitrogen uptake at flowering by the shoot and its parts.

The N uptake by the shoot and its parts at flowering and harvest in different genotypes of rice presented in **(Table-2)** indicated that irrespective of the genotypes, the mean N uptake by the leaf and stem at flowering was greater than their mean N uptake at harvest. On the contrary, the mean N uptake by the panicle and shoot at harvest was higher than their mean value at flowering. It was observed that the N uptake by the plant parts and shoot of the individual genotype at both the stages followed the similar trend as observed in their mean N uptake.

The comparison in N uptake by the stem of the genotypes at flowering indicated that Tanmayee have maximum N uptake ($4.2g/m^2$) followed by Mrunalini ($3.9g/m^2$) & Tejaswini ($3.5g/m^2$) but; the N uptake by the stem at harvest was highest in Tanmayee ($2.8g/m^2$) whereas, lowest value of the same was observed in Tejaswini ($1.7g/m^2$). The decrease in stem-N uptake of the genotypes at harvest varied from $1.4g/m^2$ in Tanmayee to $0.4g/m^2$ in Swarna sub-1 as compared to flowering.

Comparison in leaf-N uptake at flowering among the genotypes computed in **(Table-2)** reveals that Tanmayee exhibited maximum leaf-N uptake ($5.7\ g/m^2$) followed by Tejaswini ($4.7g/m^2$) and Mrunalini ($4.1\ g/m^2$) but; the same was lowest in both Pratikhya and Hiranmayee($3.2g/m^2$) . As regards to leaf-N uptake at harvest it was found that maximum leaf-N was found in Tejaswini ($4.0g/m^2$) followed by Mrunalini ($3.6g/m^2$) whereas, the minimum value of the same was showed in Swarna sub-1($1.5g/m^2$).

Comparison between the leaf-N uptake at flowering and harvesting stages it was revealed that the decrease in leaf-N uptake varied from $2.52g/m^2$ in Tanmayee to $1.0g/m^2$ in Swarna.

Variation in panicle-N uptake at flowering among the genotypes showed that the uptake was maximum in Tanmayee ($2.2g/m^2$) followed by Mrunalini ($1.8g/m^2$) whereas, the minimum uptake was observed in case of Hiranmayee ($1.3g/m^2$) **(Table-2)**. However, panicle-N uptake at harvest was highest in Tanmayee ($9.6g/m^2$) and lowest in Swarna sub-1($5.3g/m^2$) **(Table-2)**. It showed the reverse trend as compared to panicle-N uptake at flowering. The increase in panicle-N uptake among the genotypes at harvest varied from $7.4g/m^2$ in Tanmayee to $3.6g/m^2$ in Swarna sub-1 as compared to flowering.

Comparison of shoot-N uptake among the genotypes at flowering reveals that the same was maximum in Tanmayee ($13.1g/m^2$) followed by Tejaswini ($11.3g/m^2$) and minimum in both Hiranmayee and Swarna sub-1($6.6g/m^2$) as computed in **(Table-2)**. From the data it was found that the shoot-N uptake at harvest was highest in Tanmayee ($16.2g/m^2$) and lowest in Swarna sub-1($8.6g/m^2$) **(Table-2)**. The increase in shoot-N uptake at harvest varied from $3.5g/m^2$ in Mrunalini to $2.0g/m^2$ in Swarna sub-1. As regards to grain-N uptake at harvest, it was maximum in Tanmayee ($5.5g/m^2$) followed by Mrunalini ($5.0g/m^2$) but; the same was minimum in Swarna sub-1($3.7g/m^2$).

Phosphorus uptake by the shoot and its parts:

Data computed in **(Table-3)** indicated that the mean P uptake in gm/m^2 by the shoot and its parts at flowering and harvest of different genotypes of rice grown under shallow water depth condition. From the data it was revealed that mean P uptake by the stem and leaf at flowering was higher than their mean P uptake

at harvest. On the other hand the mean P uptake by the panicle at harvest was greater than the mean P uptake at flowering. Similar trend was also observed in case of shoot as in case of panicles. The mean P uptake by different parts as well as by the shoot of individual genotype at both the stages followed the similar trend as observed in their mean.

From the data computed in **(Table-3)** it was concluded that the variation in P uptake by the stem of the genotypes at flowering showed that Tanmayee had maximum P-uptake (1.0g/m^2) followed by Mrunalini (0.9g/m^2) whereas, the same was minimum in Hiranmayee (0.5g/m^2). However, highest stem-P uptake at harvest was shown in Tanmayee (0.6g/m^2) and lowest in Tejaswini (0.3g/m^2) **(Table-3)**. When compared with the P uptake between flowering and harvest of rice genotypes under test it was found that the increase in P uptake varied from 0.5g/m^2 in OR-2324-8 to 0.2g/m^2 in Swarna sub-1.

Variation in leaf-P uptake among the genotypes at flowering and revealed that both Tanmayee and Mrunalini exhibited maximum leaf-P uptake whereas, the same value was minimum in swarna sub-1 (0.2g/m^2**) (Table-3).** It was observed that at flowering Tanmayee, Mrunalini and Tejaswini showed higher leaf-P uptake than other genotypes. On the other hand, the leaf-P uptake at harvest was maximum in in both Mrunalini and Tejaswini (0.3g/m^2) followed by tanmayee (0.2g/m^2) whereas, the same value was minimum in Swarna sub-1(0.1g/m^2) **(Table-3)**. On the whole, the decrease in leaf-P uptake at harvest varied from Tanmayee (0.1g/m^2) to Swarna sub-1(0.1g/m^2) among the genotypes.

Comparison in panicle-P uptake among the genotypes at flowering computed in (**Table-3**) showed that the panicle-P uptake was maximum in Tanmayee and Mrunalini (0.3g/m^2) and minimum in both Hiranmayee & Swarna sub-1(0.2g/m^2). However, panicle-P uptake at harvest was highest in OR-2324-8 (1.0g/m^2) followed by both Tanmayee nad OR-2327-23 (0.9g/m^2) whereas, the minimum value of the same was observed in Hiranmyaee (0.5g/m^2). The increase in panicle-P uptake at harvest varied from OR-2327-23 to Hiranmayee as compared to flowering.

As regards to shoot-P uptake among the genotypes at flowering revealed that the maximum value was observed in Tanmayee (1.8g/m^2) followed by Mrunalini (1.4g/m^2) whereas, the minimum value of the same was observed in Hiranmayee (0.9g/m^2) (Table-3). Similarly, the maximum shoot-P uptake at harvest in both Tanmayee and Mrunalini (1.8g/m^2) followed by OR-2324-8 (1.7g/m^2). The lowest value was observed in hiranmayee (1.1g/m^2) (Table-3). The increase in shoot-P uptake at harvest varied from 0.5g/m^2 in OR-2324-8 to 0.2g/m^2 in Swarna sub-1.

The grain-P uptake at harvest was maximum in Tanmayee (0.7g/m^2) followed by Mrunalini (0.6g/m^2) whereas, the minimum value was observed in Hiranmayee (0.3 g/m^2) followed by Swarna sub-1(0.4 g/m^2). Irrespective of the genotypes, the percentage of partitioning of total shoot-P uptake into different plant parts at flowering exhibited the following sequence.

Stem-P uptake > Leaf-P uptake > Panicle-P uptake.

Similarly the percentage partitioning of total shoot-P uptake into different plant parts at harvest followed the pattern as stated below.

Panicle-P uptake > Stem-P uptake > Leaf-p uptake.

Potassium uptake by the shoot and its parts at flowering and harvest:

From the **(Table-4)** it was revealed that K-uptake in g/m^2 by the shoot and its parts at flowering and harvest in different rice genotypes, the mean K-uptake by the stem and the leaf at flowering was greater than their mean K-uptake at harvest. On the contrary, the mean K-uptake by the shoot and panicle at harvest was higher than their mean K-uptake at flowering.

The variation in K-uptake by the stem of the genotypes at flowering indicated that Tanmayee had maximum K-uptake (12.4g/m^2) followed by Mrunalini (11.6g/m^2) and Tejaswini (9.0g/m^2) whereas, the same value

was minimum in Hiranmayee (6.8g/m^2) **(Table-4)**. The stem-K uptake at harvest was highest in Tanmayee (11.9g/m^2) and lowest in Tejaswini (6.3g/m^2) **(Table-4)**.

Comparison of leaf-K uptake among the genotypes at flowering revealed that Tanmayee exhibited maximum (5.7g/m^2) leaf-K uptake followed by Mrunalini (4.3g/m^2) and Tejaswini (3.9g/m^2) whereas, the minimum value of the same was observed in Hiranmayee (2.8g/m^2) **(Table-4)** . However, the leaf-K uptake at harvest was highest in Tanmayee (5.5g/m^2) and lowest in swarna sub-1(2.3g/m^2). The leaf-K uptake at harvest by the genotypes varied from 2.3g/m^2 in Swarna sub-1 to 5.5g/m^2 in Tanmayee **(Table-4)**.

Comparison in panicle-P uptake among the genotypes at flowering showed that the uptake was maximum in Tanmayee (0.3g/m^2) whereas, the minimum value was observed in Swarna sub-1 (0.2g/m^2) **(Table-4)**. However, panicle-K uptake at harvest was highest in Tanmayee (5.3g/m^2) followed by OR-2324-8 (5.0g/m^2) but; the same value was minimum in case of Swarna sub-1 (3.4g/m^2) **(Table-4)**. The increase in panicle-K uptake at harvest varied from 3.1g/m^2 in Tanmayee to 1.6g/m^2 in Swarna sub-1.

Comparison of the shoot-K uptake among the genotypes at flowering and harvest revealed that the same was maximum in Tanmayee (20.9g/m^2) followed by Mrunalini (19.2g/m^2) and Tejaswini (15.7g/m^2)**(Table-4)**. However, the minimum value of the same was noted in case of Hiranmayee (11.1g/m^2) at flowering and (13.6g/m^2) at harvest. As compared from flowering to harvest the increase in shoot-K uptake varied from 5.8g/m^2 in OR-2324-8 to 0.3g/m^2 in Mrunalini. The grain-K uptake at harvest was maximum in Tanmayee (2.6g/m^2) followed by both Mrunalini and Tejaswini (2.3g/m^2) whereas, the same value was minimum in Hiranmayee (1.6g/m^2).

Irrespective of the genotypes the percentages of partitioning of total shoot-K uptake in different plant parts at flowering exhibited the following sequence.

Stem-K uptake > Leaf-K uptake > Panicle-K uptake.

Similarly the percentage of partitioning of total shoot-K uptake in different plant parts at harvest followed the pattern as stated below.

Stem-K uptake > Panicle-K uptake > Leaf-K uptake.

Percentage of partitioning of total uptake of N, P and K into different plant parts of the genotypes at flowering and harvest **(Table-2,3 & 4)** revealed that the percentage partitioning of total shoot-N into different plant parts at harvest followed the following pattern.

Panicle uptake > leaf uptake > stem uptake.

Similarly, the percentage of partitioning of total shoot-P and K uptake into different plant parts at flowering exhibited the following sequence.

Stem uptake > leaf uptake > panicle uptake.

However, partitioning of shoot-N uptake at flowering exhibited the sequence of leaf-N uptake > stem-N uptake > panicle-N uptake. Similarly, the percentage partitioning of total shoot-K uptake at harvest followed the following sequence.

Stem-K uptake > panicle-K uptake > leaf-K uptake.

Comparison of N, P and K uptake by the shoot of the genotypes at harvest revealed that irrespective of the genotypes, the mean uptake of the above nutrients by the shoot followed the following sequence.

Shoot-K uptake > shoot-N uptake > shoot-P uptake.

Similarly, the mean uptake of N, P and K uptake by the shoot followed the same pattern as observed at harvest.

The variation in N uptake by the different plant parts at flowering showed that N-uptake by the leaf and shoot was maximum in Tanmayee, whereas, the same was minimum in Hiranmayee. Similarly, N-uptake by the stem and panicle was highest in Tanmayee **(Table-2)**. On the other hand, stem-N and panicle-N uptake were lowest in OR-2324-8 and Hiranmayee respectively.

Comparison N-uptake by different palnt parts of the rice genotypes at harvest revealed that total-N uptake by the panicle,

shoot and grain was maximum in Tanmayee and minimum in Swarna sub-1 (**Table-2**). Similarly, the upotake of N by stem and leaf was highest in Tanmayee. On the contrary, stem and leaf-N uptake were lowest in Hiranmayee and Swana sub-1 respectively.

Comparison of N-uptake (g/m^2) by the shoot and its parts between flowering and harvest in different genotypes of rice showed that N uptake by the stem and leaf at flowering was greater than that at harvest indicating the translocation of this nutrient from stem and leaf to the grains during the grain filling period. On the contrary, the mean P-uptake by the panicle and shoot of the genotypes at harvest was greater than their mean P-uptake at flowering.

The variation in K-uptake by the different plant parts of the genotypes at flowering revealed that K-uptake by the stem and panicle was highest in Tanmayee and lowest in Hiranmayee **(Table-4)**. Similarly, K-uptake by the shoot and leaf was maximum in Tanmayee and minimum in Hiranmayee.

Comparison of K-uptake by the plant parts of the genotypes at harvest showed that K-uptake by the leaf and panicle was highest in Tanmayee and lowest in swarna sub-1. Similarly, the K-uptake by the shoot and grain was maximum in Tanmayee and lowest in Hiranmayee.

From the present finding, it was observed that irrespective of the genotypes, the mean K-uptake by the stem and leaf at flowering was greater that their mean K-uptake at harvest. On the other hand, the mean K-uptake by the panicle and shoot at harvest was greater than that at flowering.

The above findings are in agreement with the findings of Marschner *et al*[3]. They observed a better association of rice yield with the uptake of N, P and K at flowering and harvest.

Table 1: Variation in Total dry matter content in different plant parts of rice genotypes both at flowering & harvest

	TDM at flowering (g/m^2)				*TDM at harvest (g/m^2)*			
Variety	***stem***	***leaf***	***panicle***	***shoot***	***Stem***	***leaf***	***panicle***	***shoot***
Tanmayee	607.2 (57.41)	247.6 (23.41)	175.5 (16.59)	1057.5	485.3 (29.37)	347.4 (21.02)	836.2 (50.60)	1652.3
Mrunalini	553.7 (57.71)	215.3 (22.44)	188.0 (19.59)	959.4	447.6 (29.76)	315.6 (20.48)	740.3 (49.23)	1503.7
Tejaswini	456.9 (51.79)	207.0 (23.46)	218.3 (24.74)	882.1	270.9 (20.64)	391.4 (29.82)	651.1 (49.61)	1312.4
Swarna	375.0 (54.29)	182.3 (26.34)	133.4 (19.31)	690.7	343.6 (26.78)	261.8 (20.40)	677.9 (52.02)	1282.9
OR-2327-23	405.1 (55.39)	186.1 (25.44)	142.7 (19.51)	731.3	397.8 (30.80)	229.2 (17.74)	665.5 (51.46)	1291.5
OR-2324-8	361.9 (52.41)	163.3 (23.64)	166.0 (24.04)	690.5	341.0 (27.80)	212.2 (17.30)	673.8 (54.94)	1226.4
Pratikhya	346.5 (52.40)	157.7 (23.85)	157.0 (23.74)	661.2	345.2 (31.02)	206.1 (18.52)	562.1 (50.51)	1112.7
Hiranmayee	339.4 (54.26)	161.9 (25.88)	124.2 (19.85)	625.4	348.2 (36.02)	191.0 (17.91)	527.4 (49.54)	1066.4
Swarna -sub-1	318.7 (51.37)	148.7 (23.96)	153.4 (24.72)	620.4	381.0 (37.49)	153.8 (15.13)	482.2 (47.45)	1016.2
Mean :	471.0 (54.45)	212.0 (24.50)	182.0 (21.09)	865.0	420.0 (29.30)	289.0 (20.16)	727.0 (50.73)	1433.0
SEM :	1.554	0.740	1.230	2.705	0.543	0.330	0.571	0.998
CD 5%	4.350	2.071	3.443	7.572	1.522	0.925	1.599	2.793
CV %	0.57	0.60	1.17	0.54	0.22	0.20	0.14	0.12

*N.B: Figures in the parentheses indicate the percentage partitioning of shoot-DM.

Table-2 Variation in Nitrogen (N) uptake by different plant parts both at flowering & harvest.

	N-uptake at flowering (g/m^2)				*N-uptake at harvest (g/m^2)*				
Variety	***Stem***	***Leaf***	***Panicle***	***Shoot***	***Stem***	***Leaf***	***Panicle***	***shoot***	***Grain***
V1 Tanmayee	4.2	5.7	2.2	13.1	2.8 (-1.4)	3.5 (-2.2)	9.6 (7.4)	16.2 (3.1)	5.5
V2 Mrunalini	3.9	4.1	1.8	10.8	2.4 (-1.5)	3.6 (-0.5)	8.1 (6.3)	14.3 (3.5)	5.0
V3 Tejaswini	3.5	4.7	2.6	11.3	1.7 (-1.8)	4.0 (0.3)	7.3 (4.7)	12.6 (1.3)	4.3
V4 Swarna	2.5	3.6	1.4	7.2	2.1 (-0.4)	2.6 (-1.0)	6.6 (5.2)	10.3 (3.1)	3.7
V5 OR-2327-23	2.5	4.0	1.6	8.4	2.1 (-0.4)	2.3 (-1.7)	7.2 (5.6)	11.1 (2.7)	4.7
V6 OR-2324-8	2.2	3.3	1.7	7.4	2.0 (-0.2)	3.3 (0.0)	6.9 (5.2)	10.8 (3.4)	3.6
V7 Pratikhya	2.5	3.2	1.9	7.7	2.0 (-0.5)	2.1 (-1.1)	6.6 (4.7)	10.9 (3.2)	4.0
V8 Hiranmayee	2.3	3.2	1.3	6.6	1.9 (-0.4)	1.9 (-1.3)	5.7 (4.4)	8.7 (2.1)	3.3
V9 Swarna sub-1	2.3	3.3	1.7	6.6	2.3 (0.0)	1.5 (-1.8)	5.3 (3.6)	8.6 (2.0)	3.7
Mean :	3.0	4.0	2.0	10.0	2.0	3.0	8.0	13.0	5.0
SEM :	0.11	0.216	0.012	0.033	0.061	0.089	0.135	0.009	0.119
CD 5%	0.31	0.605	0.034	0.092	0.170	0.250	0.377	0.025	0.332
CV %	0.58	8.51	1.04	0.57	4.38	4.82	2.95	0.12	4.35

*N.B: Figures in the parentheses indicate the decrease or increase in N-uptake as compared to flowering stage

Table-3 Variation in Phosphorus (P) uptake by the different plant parts of the Rice genotypes.

	P-uptake at flowering (g/m²)				*P-uptake at harvest (g/m²)*				
Variety	*Stem*	*Leaf*	*Panicle*	*Shoot*	*Stem*	*Leaf*	*Panicle*	*Shoot*	*Grain*
Tanmayee	1.0	0.3	0.3	1.8	0.6 (-0.4)	0.2 (-0.1)	0.9 (0.6)	1.8 (0.0)	0.7
Mrunalini	0.9	0.3	0.3	1.4	0.5 (-0.4)	0.3 (0.0)	0.8 (0.5)	1.7 (0.3)	0.6
Tejaswini	0.6	0.2	0.3	1.2	0.3 (-0.3)	0.3 (0.1)	0.6 (0.3)	1.4 (0.2)	0.4
Swarna	0.7	0.2	0.2	1.1	0.4 (-0.3)	0.2 (0.0)	0.7 (0.5)	1.4 (0.3)	0.5
OR-2327-23	0.7	0.2	0.2	1.1	0.5 (-0.2)	0.2 (0.0)	0.9 (0.7)	1.5 (0.4)	0.4
OR-2324-8	0.6	0.2	0.3	1.2	0.5 (-0.1)	0.2 (0.0)	1.0 (0.7)	1.7 (0.5)	0.5
Pratikhya	0.6	0.2	0.3	1.1	0.4 (-0.2)	0.2 (0.0)	0.8 (0.5)	1.4 (0.3)	0.5
Hiranmayee	0.5	0.2	0.2	0.9	0.5 (0.0)	0.1 (-0.1)	0.5 (0.3)	1.1 (0.2)	0.3
Swarna sub-1	0.6	0.2	0.2	1.0	0.5 (-0.1)	0.1 (-0.1)	0.6 (0.4)	1.2 (0.2)	0.4
Mean :	1.0	0.22	0.25	1.0	1.0	0.20	1.0	2.0	1.0
SEM :	0.004	0.004	0.003	0.005	0.006	0.004	0.007	0.003	0.014
CD 5%	0.012	0.011	0.008	0.014	0.016	0.012	0.018	0.012	0.040
CV %	0.92	2.63	1.80	0.66	1.89	1.73	1.62	1.35	4.72

*N.B: Figures in the parentheses indicate the decrease or increase in P-uptake as compared to flowering stage.

Table 4: Variation in Potassium (K) uptake by the different plant parts of the Rice genotypes at both flowering & harvest

	K-uptake at flowering (g/m²)				*K-uptake at harvest (g/m²)*				
Variety	*Stem*	*Leaf*	*Panicle*	*Shoot*	*Stem*	*Leaf*	*Panicle*	*Shoot*	*Grain*
Tanmayee	12.4	5.7	2.2	20.9	11.9 (-0.5)	5.5 (-0.2)	5.3 (3.1)	21.8 (0.9)	2.6
Mrunalini	11.6	4.3	2.2	19.2	10.7 (-0.9)	4.4 (0.1)	4.5 (2.3)	19.5 (0.3)	2.3
Tejaswini	9.0	3.9	1.8	15.7	6.3 (-2.7)	5.8 (1.9)	4.5 (2.7)	16.8 (1.1)	2.3
Swarna	7.7	3.6	1.6	14.2	8.1 (0.4)	3.1 (-0.5)	4.6 (3.0)	17.3 (3.1)	2.1
OR-2327-23	8.6	3.0	1.7	14.0	9.5 (0.9)	2.7 (-0.3)	4.1(2.4)	17.0 (3.0)	2.1
OR-2324-8	6.8	2.9	1.9	12.1	7.9 (1.1)	2.5 (-0.4)	5.0 (3.1)	17.9 (5.8)	2.1
Pratikhya	6.9	3.0	1.6	12.6	8.3 (1.4)	2.6 (-0.4)	3.4 (1.8)	14.0 (1.4)	1.6
Hiranmayee	6.8	3.0	1.2	11.1	8.2 (1.4)	3.0 (0.0)	3.5 (2.3)	13.6	1.6
Swarna sub-1	6.9	2.9	1.8	13.0	9.2 (2.3)	2.3 (-0.6)	3.4 (1.6)	14.0	1.8
Mean :	10.0	4.0	2.0	17.0	10.0	4.0	5.0	19.0	2.0
SEM :	0.049	0.018	0.111	0.053	0.026	0.047	0.013	0.013	0.051
CD 5%	0.136	0.050	0.011	0.149	0.072	0.131	0.037	0.036	0.142
CV %	0.88	0.77	9.63	0.55	0.44	2.04	0.47	0.12	3.81

*N.B: Figures in the parentheses indicate the decrease or increase in K-uptake as compared to flowering stage.

CONCLUSION

N uptake by the leaf and shoot of the genotypes at flowering was maximum in Tanmayee and minimum in Swarna sub-1. it was revealed that the P-uptake by the leaf, panicle and shoot at flowering was maximum in Tanmayee. the uptake of the P by the panicle at harvest was maximum in OR-2324-8 The K-uptake of by the stem and panicle at flowering was found to be highest in Tanmayee and lowest in Hiranmayee The K-uptake of by the leaf and the panicle at harvest was maximum in Tejaswini and Tanmayee respectively and lowest in Swarna sub-1The K uptake by stem was the maximum in case of Hanseswari whereas the same by leaf and panicle was found to be the maximum in Varsadhan. The NPK uptake by the grain wasmaximum in Tanmayee (g/m^2) where as the minimum uptake of the same was recorded in Hiranmayee (g/m^2) in the study area.

REFERENCES

1. A.O.A.C., Official method of analysis. Association of Official Analytical Chemists. 17th Ed. Inc., Maryland, USA (2000).
2. Dalmia, Ann and Sawhney, Veena , Anti oxidant defense mechanism under drought stress in wheat seedling. *Physiol.Mol.Biol. Plant* **10(1):**109-114 (2004).
3. Jackson, M.L., Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, 38-56 (1973).
4. Marschner, H., In Mineral Nutrition of Higher Plants. Academic Press, New York. 195-268 (1995).
5. Paroda, R. S., Strategy for increasing productivity growth rate in agriculture. *PIB Government of India* online information **30:** 11 (2006).