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Correlation Studies of Growth and Yield Attributes with Grain Yield of Scented Rice as Influenced by Nano Urea in Combination with Inorganic Fertilizer and Organic Manure

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Appropriate nitrogen management increases the yield of rice. Both excess and low nitrogen content leads to lower the production of rice. A large amount of nitrogen causes soil fertility loss and thus, the yield. Nano urea is a nano technology that provides nitrogen required for crop at critical stages. Keeping these in mind a research experiment was carried out to assess the correlation studies of growth and yield attributes with grain yield of scented rice as influenced by Nano urea in

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combination with inorganic fertilizer and organic manure at Instructional Farm Unit, Krishi Nagar, JNKVV, Jabalpur during the rainy season of 2022 and 2023. Ten treatment combinations were laid out in randomized block design with four replications. The results revealed that all the growth parameters were observed a strong and positive correlation with grain yield of rice. The regression analysis showed a strong positive linear relationship with the growth parameters viz., plant height (95% and 97%, respectively) and no. of tillers hill^{-1} (94% and 91%, respectively), yield attributes viz., panicle length (94% and 95%, respectively) and total no. of grains panicle^{-1} (97% and 95%, respectively) and grain yield of rice. This concludes that all the growth and yield attributes positively contributed towards gaining higher yield.

Keywords: Nano urea; vermicompost; Azospirillum; foliar application; correlation; regression and yield.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is an important source of carbohydrate, extensively grown worldwide for food grains. Globally, rice is cultivated on 473.80 million hectares (Mha) as of the year 2019 [1], with a production of 177.64 million tons (MT). In India, it covers an area of 43.66 Mha with a production of 118.87 MT [2]. The increasing population has accelerated the demand for higher production to feed the population. In order to meet this demand, farmers in many parts of the world use nitrogenous fertilizer in an indiscriminate amount. This not only pollutes the environment but also increases the production cost. Since nitrogen is a key element required to enhance the rice production, integrating inorganic, organic, and biofertilizer with Nano urea could be an option for the aforementioned problem. This integration leads to increased production and profitability in rice [3]. Nitrogen is one of the most important nutrient for crop growth and productivity [4]. Nitrogen being an integral part of chlorophyll, positively influence the interception of photosynthetically active radiation (PAR) and hence, the dry matter accumulation and grain yield [5]. Gajbhiye et al. [6] reported a positive influence of chlorophyll content and yield of wheat crops. Inorganic fertilizer provides major nutrients quickly to the soil solution, but a high amount leads to serious environmental problems such as soil acidification and ground-water pollution, in addition to the loss of soil fertility. Therefore, reducing the use of chemical fertilizer is the need for an hour. Organic manure has a bright prospect in improving the soil quality and nurturing the soil by providing a source of energy to soil micro fauna. Vermicompost make available the nutrients, with growth hormones. It is a good source of almost all essential nutrients (primary, secondary and micronutrients [7]. It increases the cation exchange capacity and improves the soil physical health [8]. Hence, it provides twin advantage of increasing nutrients and soil health improvement. Kumar et al. [9] also noted positive influence of inorganic and organic fertilizer with bio-inoculant on the grain yield of rice. *Azospirillum* being a low cost, ecofriendly source of plant nutrients is a sound option for increasing the yield of rice. Nano particles have large surface area, high activity due to surface volume ratio, leads to more absorption and easy translocation of nano particles thus, enhance the nutrient use efficiency. Over 1 mm of urea prill, Nano urea contains 5500 nitrogen particles that reduces the need of conventional fertilizers and indirectly advantage to soil health. Also, it is less expensive which can boost up the economics of marginal farmers. Although extensive studies are done, the need for Nano urea with conventional urea and vermicompost needs to be assessed. Therefore, keeping all these facts in mind present study was undertaken to evaluate the correlation of growth and yield attributes with grain yield of scented rice.

2. MATERIALS AND METHODS

The field experiment was conducted for two consecutive years 2022 and 2023 during the rainy season at Instructional Farm Unit, Krishi Nagar, JNKVV, Jabalpur. The soil of the experimental field was clay loam in texture with neutral pH and medium in OC (%), available N, P_2O_5 and K_2O beside normal electrical conductivity. Ten treatments comprised of T_1, Control (0% N + 0% P + 0% K); T_2, 100% N through urea + 100% P + 100% K (100:60:40 kg ha^{-1}); T_3, 75% N through urea + FS with Nano urea @ 4 ml litre^{-1} at active tillering (AT) and panicle initiation (PI); T_4, 50% N through urea + FS with Nano urea @ 4 ml litre^{-1} at AT and PI; T_5, 75% N through urea + *Azospirillum* @ 5 kg ha^{-1} + FS with Nano urea @ 4 ml litre^{-1} at AT and PI; T_6, 50% N through urea + *Azospirillum* @ 5 kg ha^{-1} + FS with Nano urea @ 4 ml litre^{-1} at AT and PI; T_7, 75% N through vermicompost + FS

with Nano urea @ 4 ml litre^{-1} at AT and PI; T_8, 50% N through vermicompost + FS with Nano urea @ 4 ml litre^{-1} at AT and PI; T_9, 75% N through vermicompost + *Azospirillum* @ 5 kg ha^{-1} + FS with Nano urea @ 4 ml litre^{-1} at AT and PI; T_{10}, 50% N through vermicompost + *Azospirillum* @ 5 kg ha^{-1} + FS with Nano urea @ 4 ml litre^{-1} at AT and PI was laid out in randomized block design. All the treatments were replicated four times. The recommended dose of fertilizer was 100:60:40 NPK kg ha^{-1}, half quantity of urea and whole quantity of P and K, (through SSP and MOP, respectively), vermicompost and *Azospirillum* were applied as per the treatment assigned as basal and remaining half quantity of urea was applied in again two split doses at AT and PI stage. The rice variety PS 4 was selected for the present investigation and all the package of practices were followed as per the recommendation of this area. Various data on growth and yield attributes were tabulated, analyzed, and presented in the form of table and figure. The grain yield and straw yield were taken after sun drying the crop and expressed in kg ha^{-1}.

2.1 Statistical procedure

The data were statistically analyzed using OPSTAT software available online at CCS, HAU, Haryana [10]. The data were subjected to statistical analysis by using analysis of variance (F-test) as suggested by Gomez and Gomez [11].

3. RESULTS AND DISCUSSION

3.1 Relationship between Growth parameters, Yield Attributes and Grain yield (kg ha^{-1})

All the growth parameters viz., no. of tillers hill^{-1} and plant height (cm), yield attributes i.e., panicle length (cm) and total no. grains panicle^{-1} and grain yield (kg ha^{-1}) showed a positive linear relationship with grain yield.

3.1.1 Relationship between plant height (cm) and grain yield (kg ha^{-1})

Regression study between grain yield (kg ha^{-1}) with plant height (cm) showed a positive linear relationship (Fig. 1a & 1b). These results revealed that with the increase in plant height (cm), the grain yield increases. The coefficient of determination shows 95% and 97% variation in grain yield during 2022 and 2023, respectively. This might be because of better availability of nitrogen by their active absorption and transportation of Nano urea due to its smaller size that might have improved utilization of nutrient for metabolism thereby more plant height so the higher grain yield. Namasharma et al. [12], [9] and [13] also observed positive relationship between yield and growth parameters.

3.1.2 Relationship between no. of tillers hill^{-1} and yield (kg ha^{-1})

Regression study between grain yield (kg ha^{-1}) with no. of tillers hill^{-1} showed a positive linear relationship (Fig. 2a & 2b). This clearly indicates that with the increase in no. of tillers hill^{-1} the grain yield increases. The coefficient of determination shows 94% and 91% variation in grain yield due to no. of tillers hill^{-1} during 2022 and 2023, respectively. This might be due better availability of nitrogen by their easy absorption and transportation of Nano urea due to its smaller size that might have favored efficient utilization of nutrient for metabolism thereby healthier plants so the higher grain yield. [10] and [9] also observed positive relationship between yield and growth parameters. Rathnayaka et al. [14] and [15] also observed more growth and yield of rice with the application of Nano urea and urea.

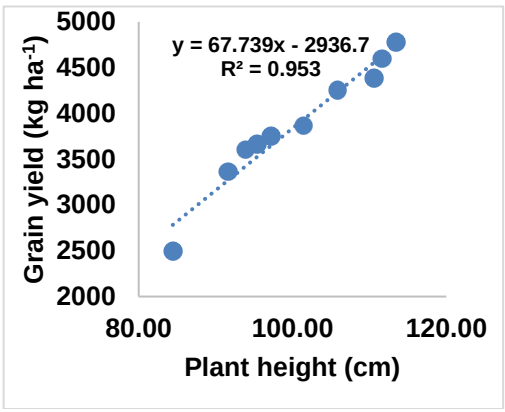
3.1.3 Relationship between panicle length (cm) and yield (kg ha^{-1})

Regression analysis indicated that grain yield (kg ha^{-1}) with panicle length (cm) showed a positive linear relationship (Fig. 3a & 3b). This shows that with the increase in panicle length (cm), grain yield increases. The coefficient of determination shows 94% and 95% variation was due to panicle length during 2022 and 2023, respectively. This might be due to more yield attributes that positively enhanced yield of rice. Kumar et al. [9] also observed that as the yield attributes increased grain yield also increased. Bhargavi and Sundari [16] observed positive relationship between yield attributes and grain yield. Namasharma et al. [12] also observed positive relationship between yield attributes and grain yield.

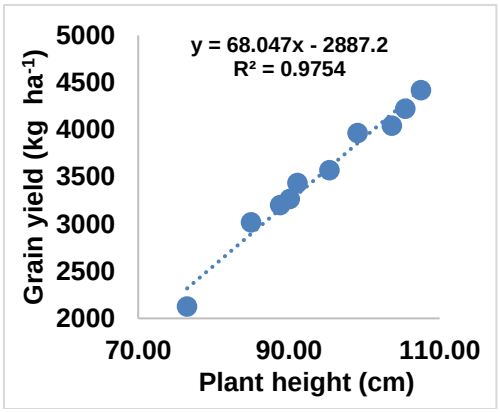
3.1.4 Relationship between total no. of grains panicle^{-1} and yield (kg ha^{-1})

Regression analysis between grain yield (kg ha^{-1}) with total no. of grains per panicle showed a positive linear relationship (Fig. 4a & 4b). This clearly shows that with the increase in total no. of grains panicle^{-1}, grain yield increases. The

coefficient of determination shows 96% and 95% variation during 2022 and 2023, respectively. This might be because of availability of nitrogen at panicle initiation stage that increased the number of flowers that positively enhanced no. of grains and hence, the grain yield of rice. Midde et al. [15] observed positive relationship between yield attributes and grain yield. Namasharma et al. [12] and [9] also observed positive relationship between yield attributes and grain yield. Rathnayaka et al. [14] and [15] also observed more yield and yield attributes of rice with the application of Nano urea and urea.

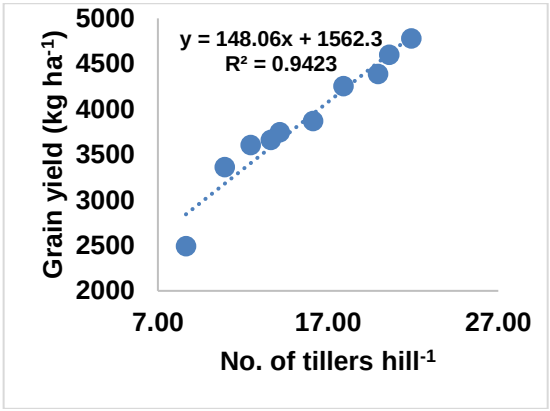


(Fig. 1a 2022)

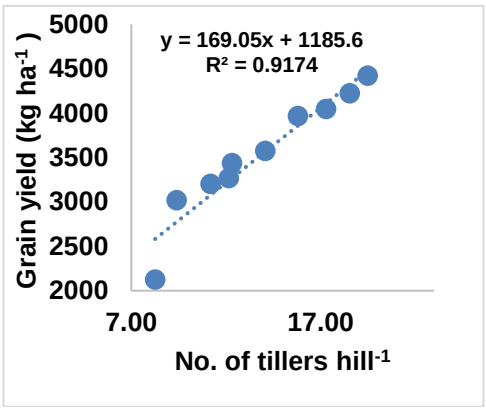


(Fig. 1b 2023)

Fig. 1. Relationship between plant height (cm) and grain yield (kg ha^{-1})

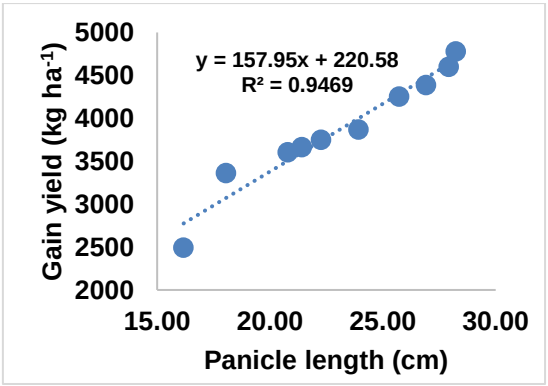


(Fig. 2a 2022)



(Fig. 2b 2023)

Fig. 2. Relationship between no. of tillers hill^{-1} and grain yield (kg ha^{-1})



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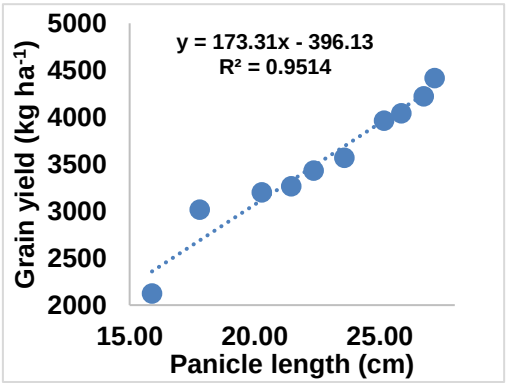
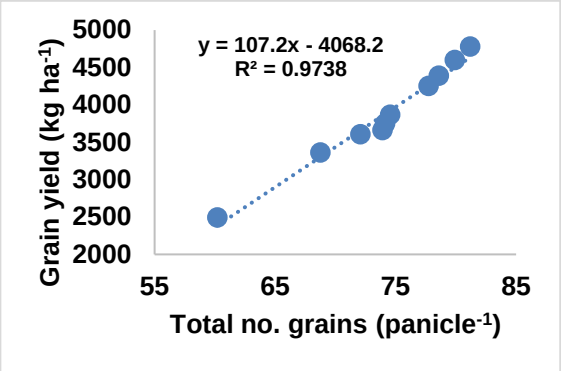
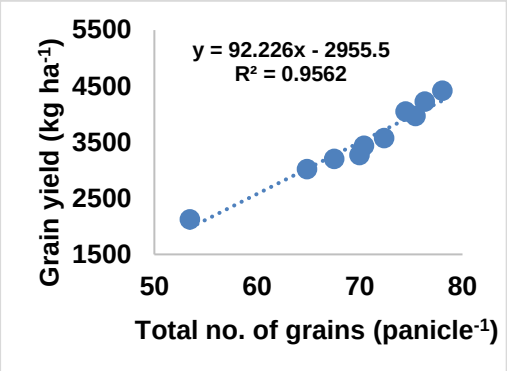


(Fig. 3b 2023)

Fig 3. Relationship between panicle length (cm) and grain yield (kg ha^{-1})



(Fig. 4a 2022)



(Fig. 4b 2023)

Fig 4. Relationship between total number of grains (panicle^{-1}) and grain yield (kg ha^{-1})

Table 1a. Correlation studies between growth parameters, yield attributes and grain yield of rice during the year 2022

	Grain Yield (kg ha^{-1})	Plant height (cm)	No. of tillers hill^{-1}	Panicle length (cm)	Total no. of grains (panicle^{-1})
Grain yield (kg ha^{-1})	1				
Plant height (cm)	0.9762***	1			
No. of tillers hill^{-1}	0.9708***	0.9973***	1		
Panicle length (cm)	0.9731***	0.9901***	0.9926***	1	
Total no. of grains (panicle^{-1})	0.9868***	0.9431***	0.9389***	0.9551***	1

*Significance level: **0.05 and *** 0.01*

Table 1b. Correlation studies between growth parameters, yield attributes and grain yield of rice during the year 2023

	Grain Yield (kg ha^{-1})	Plant height (cm)	No. of tillers hill^{-1}	Panicle length (cm)	Total no. of grains (panicle^{-1})
Grain yield (kg ha^{-1})	1				
Plant height (cm)	0.9876***	1			
No. of tillers hill^{-1}	0.9579***	0.9876	1		
Panicle length (cm)	0.9754***	0.9851***	0.9780***	1	
Total no. of grains (panicle^{-1})	0.9778***	0.9453***	0.8965***	0.9519***	1

*Significance level: **0.05 and *** 0.01*

3.2 Correlation Studies among Growth parameters, Yield attributes and grain yield (kg ha^{-1})

The grain yield showed a significant positive correlation with plant height, no. of tillers, panicle length and total no. of grains panicle^{-1} (Table 1a and 1b). This shows that all the growth parameters and yield attributes assisted in gaining more yield. Kumar et al. [9] also observed that all the growth parameters, yield attributes are positively correlated with the grain yield.

4. CONCLUSION

Based on the findings of the experiment, it can be concluded that all the growth parameters (plant height and no. of tillers hill^{-1}) and yield attributes (panicle length and total no. of grains) exhibited a strong positive relationship with grain yield which suggests that all the parameters positively contributed to gain higher yield.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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