Original Research Article

Correlation studies of growth and yield attributes with grain yield of scented rice under application of Nano urea in combination with inorganic fertilizer and organic manure

ABSTRACT

Appropriate nitrogen management increase 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 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. 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, grown extensively for food grain in the world. Globally, rice is grown in 473.80 million hectare (Mha) in the year 2019 [1] with the production of 177.64 million tons (MT). In India, it is grown in 43.66 Mha area with the production of 118.87 MT [2]. With the increasing population, accelerated the demand for higher production to feed the population. In order to meet the demand, farmers in many parts of the world use nitrogenous fertilizer in an indiscriminate amount. This not only pollutes the environment but increases the production cost. Since nitrogen is a key element required to enhance the production in rice, integration of inorganic, organic and bio fertilizer with Nano urea could be an option for the foresaid problem. It leads to increase production and profitability in rice [3]. Nitrogen being an integral part of chlorophyll, positively influence the interception of photosynthetically active radiation and hence the yield of rice. [4] reported a

positive influence of chlorophyll content and yield of wheat crop. Inorganic fertilizer provides major nutrients quickly into the solution but a high amount leads to serious environmental problems like soil acidification and ground water pollution besides the loss of soil fertility. Therefore, reducing the amount of use of chemical fertilizer is a need for hour. Organic manure has bright prospectus 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 increases the cation exchange capacity and improves the soil physical health [5]. Hence, it provides twin advantage of increasing nutrients and soil health improvement. [6] 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 1mm 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 100:60:40N:P:K, 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. 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 the 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 [7]. The data were subjected to statistical analysis by using analysis of variance (F-test) as suggested by [8].

3. RESULTS AND DISCUSSION

3.1 Relationship between growth, yield attributes and grain yield (kg ha^{-1})

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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 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). This 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 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. [9] and [6] 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 indicated 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. [9] and [6] also observed positive relationship between yield and growth parameters. [10] and [11] 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 (kgha^{-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. [6]observed that as the yield attributes increased grain yield also increased. [12] observed positive relationship between yield attributes and grain yield. [9] also observed positive relationship between yield attributes and growth parameters.

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. [12] observed positive relationship between yield attributes and grain yield. [9]and [6] also observed positive relationship between yield attributes and growth parameters. [10] and [11] also observed more yield and yield attributes of rice with the application of Nano urea and urea.

Fig1. Relationship between Plant height and grain yield

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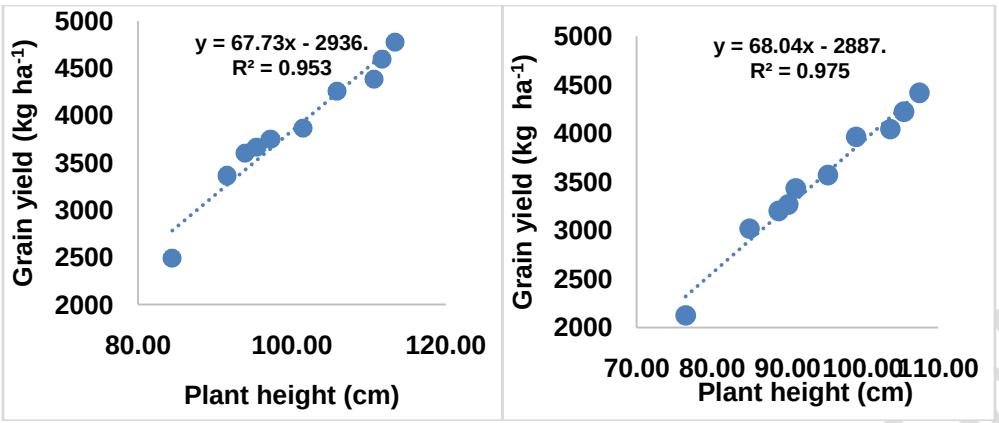
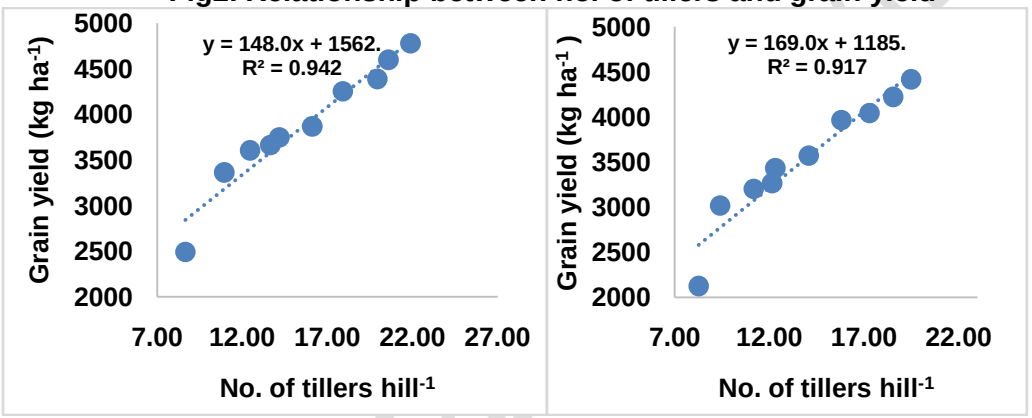


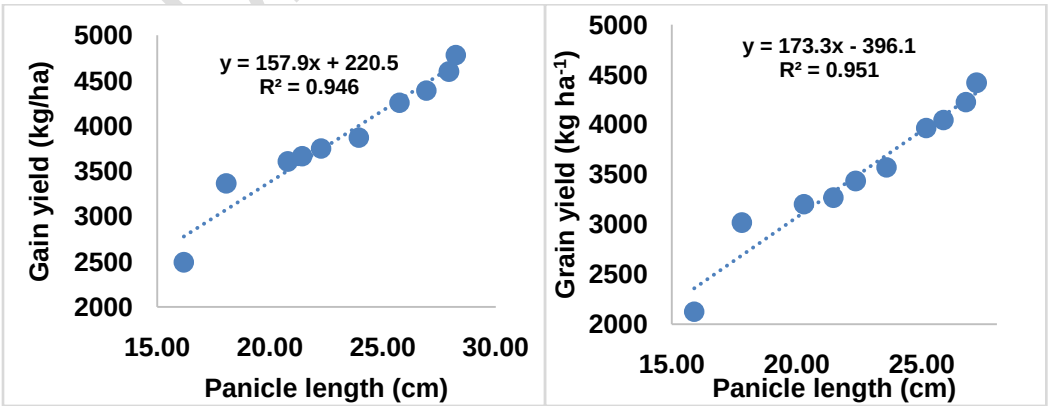
(Fig 1a 2022)(Fig 1b 2023)

Fig2. Relationship between no. of tillers and grain yield



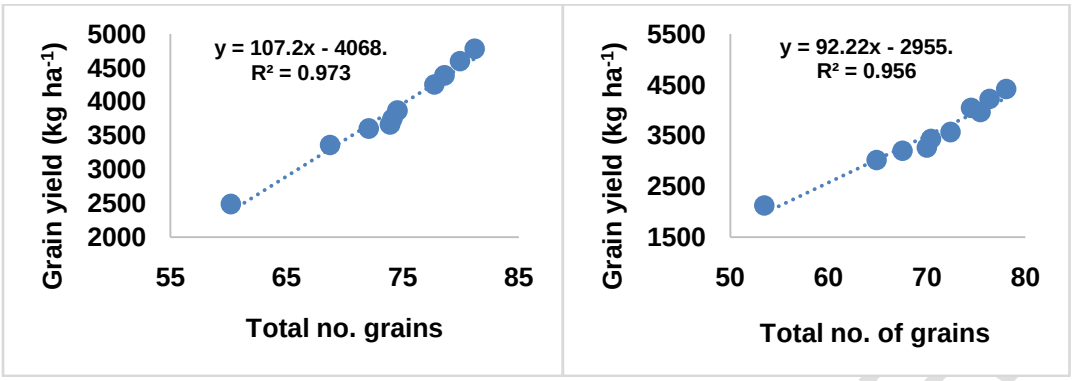
(Fig 2a 2022)(Fig 2b 2023)

Fig 3. Relationship between panicle length and grain yield



(Fig.3a 2022)(Fig.3b 2023)

Fig 4. Relationship between total number of grains andgrain yield Panicle^{-1}



(Fig 4a 2022)(Fig 4b 2023)

3.2Correlation studies among growth, yield attributes and yield (kg ha^{-1})

The grain yield showed a significant positive relationship with plant height, no. of tillers, panicle length and total no. of grains per panicle (Table 1a and 1b). This shows that all the growth parameters and yield attributes assisted in gaining more yield. [6] also observed that all the growth parameters, yield attributes are positively correlated in gaining higher yield.

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

	Grain Yield (kg/ha)	Plant Height (cm)	No. of tillers	Panicle length (cm)	Total No of grains (Panicle^{-1})
Grain yield (kgha^{-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 (Per Panicle)	0.9868***	0.9431***	0.9389***	0.9551***	1

Significance level: **0.05 and *** 0.01

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

	Grain Yield (kg/ha)	Plant Height (cm)	No. of tillers	Panicle length (cm)	Total No of grains (Panicle^{-1})
Grain yield (kgha^{-1})	1				

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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

4. CONCLUSION

Based on the findings of the experiment, it can be concluded that all the growth parameters (plant height and no. of tillers) and yield attributes (panicle length and total no. of grains) showed a strong positive relationship with grain yield which suggests that all the parameters were high with the foresaid treatment which contributed to higher yield.

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