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EFFECT OF NAPHTHALENE ACETIC ACID AND DIFFERENT PHOSPHORUS LEVELS ON PANICLES, SPIKELETS, STERILITY, NORMAL KERNEL, YIELD AND BENEFIT COST RATIO OF RICE

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ABSTRACT

Growth and yield attributes of rice were evaluated with the application of varying doses of Naphthalene Acetic Acid (NAA) and Phosphorus during 2004 and 2005. The experiment was laid out in Randomized Complete Block (RCB) Design with split-plot arrangements and replicated four times. Main plots were assigned to four levels (0, 60, 90 and 120 ml ha^{-1}) of NAA. Results revealed that NAA @ 90 ml ha^{-1} and phosphorus application up to 100 kg ha^{-1} boosted up the rice productivity due to maximum value recorded in terms of panicles m^{-2} (347.5 and 349.5), spikelets panicle^{-1} (153.3 and 153.8), sterility (22.25 and 19.94 %), normal kernel (77.25 and 78.69 %), paddy yield (7.62 and 7.82 t ha^{-1}) and net income (Rs. 30986 and 32236 ha^{-1}) with BCR of 1.64 and 1.70 indicating the economical yield of rice during 2004 and 2005.

Key words: Rice, Naphthalene Acetic Acid, Growth Regulator, Phosphorus Levels.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple foods for nearly half of the world's population, most of them living in developing countries. The crop occupies one of the world's total areas planted to cereals, providing 50-60 percent of the calories to 2.7 billion peoples (Belder *et al*., 2004). Pakistan ranked 5th in rice production in the world and is the 3rd crop after wheat and cotton by sharing an area of 2883 thousand hector with the production of 6883 thousand tons at an average yield of 2.38 t ha^{-1} (Anonymous, 2010) which is very low as compared to other rice producing countries. There are many factors of low yield of rice crop. The most important one is imbalance use of nutrients. Phosphorus after nitrogen is the key element for crop production and is generally available to the plants when soil pH is 6-6.5. Mostly in Pakistan, soils are alkaline in nature due to which its availability is seriously affected by the formation of poorly soluble calcium phosphate minerals. The crop grown under such conditions can be structured with shorter internodes and poor root development resulting low yield and economic loss. Phosphorus is important for root development, increase resistant to lodging, reduced flower shedding, increased grain weight, improve seedling vigor and seed quality (Henry *et al*., 1995).

The introduction of chemical growth regulators has added a new dimension to the possibility for improving the growth and yield of rice corp. In principle, the availability of exogenous bio-regulators to modify plant growth offers great opportunity. Plant growth regulators generate metabolic and physiological responses in plants by affecting their growth and development (Hayat *et al.,* 2010). Similarly, Chohi *et al.* (2010) stated that application of PGR increased paddy yield. Whereas, Reddy *et al.* (2009) reported that application of NAA increased yield and yield components of rice. The interaction of plant growth regulator (NAA) and Phosphorus levels had significantly beneficial effect on the yield attributes of rice (Imam *et al*., 2010). The similar study was also conducted by Niamatullah *et al*., (2011). The present study was focused on these lines, keeping in view the interaction of plant growth regulator and phosphorus levels to enhance the paddy yield and benefit cost ration (BCR) values.

MATERIALS AND METHODS

The research project was undertaken at the Postgraduate Agricultural Research Farm, Gomal University, Dera Ismail Khan, Pakistan during 2004 and repeated in 2005. The nature of soil was clay with pH value of 7.9 and 8.1 during both the years. Randomized complete block (RCB) design having split-plot arrangements was used in the experiment which was replicated four times. Main plots were assigned to four levels (0, 60, 90 and 120 ml ha^{-1}) of Phytofix (NAA 4.5 % in sodium salt) while five doses of phosphorus (0, 50, 100, 150 and 200 kg ha^{-1}) were kept in sub-plots of 3 x 5 m^{-2} size. Phytofix was applied at the time of panicle initiation with the help of skilled labor by hand sprayer whereas phosphorus was applied to the soil at the time of seed bed preparation before transplanting the rice nursery. While N @ 120 kg ha^{-1} was applied in two split levels, half at the time of transplanting and remaining half at the time of panicle initiation. The rice seedlings of 35 days age, free of pests and diseases were transplanted in the plots using row to row and plant to plant spacing of 20 cm with two seedlings per hill by trained manual labors on 15th June each year. All other agronomic practices such as hand weeded with the help of skilled labour, efficiency of irrigation regimes, which were I1-60 cm, I2-75 cm, I3-90 cm and I4-105 cm maintained accordingly till the maturity to meet the water requirements of the crop. Depth of 7.5 cm of each irrigation was maintained through out the crop growing period to ensure moisture contents available in root zone of crop at field capacity. The pooled data collected were tabulated and analyzed statistically using analysis of variance techniques (Steel *et al*., 1997) and subsequently using Least Significance Difference (LSD) test for comparing the treatment means.

RESULTS AND DISCUSSION

Number of panicles (m^{-2}): Results regarding the number of panicles m^{-2} (Table 1) were significantly affected by the application of different levels of plant growth regulator and phosphorus levels. Among various levels of NAA, application of 90 ml ha^{-1} gave the maximum panicles (346.6 & 348.2) per unit area while it was minimum (319.8 & 322.0 m^{-1}) when growth regulator was not applied, during 2004 and 2005, respectively. Application of NAA @ 100 g ha^{-1} increased the number of grains per panicle, percentage of filled spikelets, 1000-grain weight and thus final yield (Reddy *et al*., 2009). The results were also supported by Dengon *et al.* (1996) who reported that NAA @ 100 ml ha^{-1} performed well in improving the yield and yield attributes like productive tillers m^{-2}, panicles m^{-2}, spikelets $panicle^{-1}$, normal kernels percentage, 1000-grain weight and paddy yield. As far as the effect of phosphatic fertilizer doses on number of panicles m^{-2} of rice crop is concerned, highly significant differences were recorded. During both years, maximum number of panicles m^{-2} (347.5 & 349.5) were recorded in the treatment with 100 kg P_2O_5 ha^{-1}, however, the lowest number of panicles (317.8 & 319.3 m^{-2}) were observed in the plots without phosphatic fertilizer. The results are in line with Begum *et al*. (2002) who reported the highest bearing tillers $hill^{-1}$ from seedling raised with recommended NPK due to proper nutrients availability. The interaction between two factors also remained significant during 2004 and 2005. The treatment combination of G2P2 (90 ml NAA + 100 kg P_2O_5 ha^{-1}) was on top with maximum number of panicles (360.0 & 362.0 m^{-2}) during both the experimental years due to substantial effect of plant growth regulator (NAA).

Number of spikelets $panicle^{-1}$: The data recorded on number of spikelets $panicle^{-1}$ are presented in Table 2. The data revealed that doses of plant growth regulator affected the number of spikelets $panicle^{-1}$ significantly during both the cropping seasons. The data revealed that the plant growth regulator dose of G2 (90 ml ha^{-1}) showed maximum number of spikelets $panicle^{-1}$ (154.8 and 155.8) during 2004 and 2005, respectively, followed by plant growth regulator dose of G3 (120 ml ha^{-1}) with the values of 142.2 and 142.1. It is obvious from the data that lowest number of spikelets $panicle^{-1}$ (128.0 and 128.0) were recorded in plots without growth regulator application during 2004 and 2005. Kato *et al.* (2004) also reported that increased number of spikelets $panicle^{-1}$ with the application of GA. The phosphatic fertilizer doses significantly affected the number of spikelets $panicle^{-1}$ during both years. The maximum number of spikelets $panicle^{-1}$ were recorded in the treatment P2 (100 kg P_2O_5 ha^{-1}) with the value of 153.3 and 153.8. However, during both the years of studies the lowest number of spikelets $panicle^{-1}$ (128.8 and 131.0) were observed in the plots without phosphatic fertilizer. Similar results were observed by Qadir and Ansari (2006) who stated that high P levels are needed for more spikelets numbers.

The interaction of plant growth regulator levels and phosphatic fertilizer was highly significant with regards to number of spikelets $panicle^{-1}$ during 2004 and 2005. The treatment combination of G2P2 (90 ml ha^{-1} with 100 kg ha^{-1} phosphatic fertilizer) was on top in with maximum number of spikelets $panicle^{-1}$ (166.0 and 168.0) during 2004 and 2005. The lowest number of spikelets $panicle^{-1}$ were noted in treatment G0P0 (without plant growth regulator and phosphatic fertilizer application) with 109.0 and 112.0 spikelets $panicle^{-1}$ during 2004 and 2005, respectively. In case of number of panicles, year's interaction with treatments was found non-significant.

Sterility percentage: The data recorded on sterility percentage are presented in Table 3. The Table depicts that doses of plant growth regulator differed significantly from each other with regards to sterility percentage during both the cropping seasons. The data revealed that the plant growth regulator dose of G2 (90 ml ha^{-1}) showed minimum sterility (17.2 and 16.04 %) during 2004 and during 2005, respectively. It was followed by plant growth regulator doses of G1 and G3 (60 and 120 ml ha^{-1}). It is obvious from the data that highest sterility (22.31 and 20.24 %) was calculated in the plots without plant growth regulator application during 2004 and 2005. Reddy *et al*. (2009) observed lowest sterility percentage with the application of NAA @ 100 g ha^{-1}. As far as the effect of phosphatic fertilizer doses on sterility percentage is concerned it was observed that sterility percentage was affected significantly by various phosphorus levels. During both the years the minimum sterility percentage was recorded in the treatment P2 (100 kg P_2O_5 ha^{-1}) with the value of 18.29 and 17.41 %. However, during both the years of studies the highest sterility (22.25 and 19.94 %) was observed in the plots without phosphorus application due to high stress of pollen for nutrients facilitated high sterility. The results are in line with Begum *et al*., (2002) who reported that lowest sterile spikelets $panicle^{-1}$ were found using recommended level of NPK.

The interaction of plant growth regulator levels and phosphatic fertilizer was highly significant during 2004 and 2005 with regards to sterility percentage. The treatment combination of G2P2 (90 ml ha^{-1} with 100 kg P_2O_5 ha^{-1}) showed minimum sterility (16.00 and 15.00 %) during 2004 and 2005, respectively. The highest value of sterility percentage was noted in treatment without plant growth regulator and phosphatic fertilizer application showing 25.70 and 22.00 % during 2004 and 2005, respectively. In case of number of sterility, year's interaction with treatments was found non-significant.

Normal kernels percentage: The data recorded on normal kernels percentage are presented in Table 4. The data in Table 4 depicted that doses of plant growth regulator differed significantly from each other with regards to normal kernels percentage during both the years. The data revealed that the plant growth regulator dose of G2 (90 ml ha^{-1}) showed maximum normal kernels (77.75 and 79.20 %) during 2004 and 2005, respectively, followed by plant growth regulator dose of G1 and G3 (60 and 120 ml ha^{-1}). It is obvious from the data that lowest normal kernels (57.80 and 59.60 %) was calculated in the plots without plant growth regulator application during both the years of study. Chenniappan *et al*. (2004) reported that foliar application of GA3 recorded higher seed set. The phosphatic fertilizer doses significantly affected the normal kernels percentage during both years. Maximum normal kernels percentage was recorded in the treatment with P2 (100 kg P_2O_5 ha^{-1}) with the value of 77.25 and 78.69 % during 2004 and 2005, respectively. However during both the years of studies the lowest normal kernels (59.25 and 61.25 %) were observed in the plots without phosphatic fertilizer. The results are in line with Prakash *et al*. (2007) who reported that addition of P increased the number of normal kernels.

The interaction of plant growth regulator levels and phosphatic fertilizer was highly significant during 2004 and 2005 with regards to normal kernels percentage. The treatment combination of G2P2 (90 ml ha^{-1} with 100 kg ha^{-1} phosphatic fertilizer) showed maximum normal kernels (88.00 and 87.00 %) during the year 2004 and 2005. The lowest value of normal kernels percentage was noted in treatment without plant growth regulator and phosphatic fertilizer application with the value of 50.00 and 52.00 % during 2004 and 2005, respectively.

Paddy yield (t ha^{-1}): Data presented in Table 5 shows that the effect of plant growth regulator (NAA) significant during both the years of study with respect to paddy yield. It revealed that 90 ml ha^{-1} NAA gave maximum paddy yield (7.54 & 7.62 t ha^{-1}) during 2004 and 2005, respectively. Further increase in the dose of NAA declined the paddy yield. The lowest paddy yield was recorded as 5.52 & 5.70 t ha^{-1} when no plant growth regulator was applied. Choi *et al*. (2010) and Hayat *et al*. (2010) reported increased in paddy yield by the application of plant growth regulator. Pandey *et al*. (2001) also stated that higher dose of IAA @ 50 ppm significantly increased grain yield of 5.53 against 4.72 t ha^{-1} (control). They further described that increase in grain yield was mostly contributed by increased chlorophyll content, panicles per plant and grains per panicle, grain weight per plant. In present study phosphatic fertilizer levels had highly significantly affected paddy yield during both the years of study. The maximum paddy yield (7.62 & 7.82 t ha^{-1}) was recorded in 100 kg P_2O_5 ha^{-1} applied treatments. However, during both the years of study, the lowest significant paddy yield (5.40 & 5.61 t ha^{-1}) was observed in non-phosphorus treated plots. The results are in line with that of Maqsood *et al*. (2001) who reported that higher paddy yield was obtained in plots receiving 120-100 kg NP ha^{-1} while high phosphorus levels needed for grain yield enhancement (Sudhakar *et al*., 2004; Qadir and Ansari, 2006). The interaction between application of growth regulator and P-levels was also highly significant during both the years of study with respect to paddy yield. NAA @ 90 ml along with 100 kg P_2O_5 ha^{-1} gave the maximum paddy yield (8.70 & 8.90 t ha^{-1}) during 2004 and 2005, respectively. Ezehiel (2006) reported that grain yield increased by N and plant growth regulators whereas Prakash *et al*. (2007) stated that addition of phosphorus with or without rice hull ash as a source of silicon increased paddy yield.

Economic analysis and benefit cost ratio calculation: Economic analysis and benefit cost ratio (BCR) pertaining to effect of plant growth regulator and phosphorus levels on the yield and yield components of transplanted coarse rice during both the years are presented in Table 6. The data depicts that maximum net income of Rs. 30986 and 32236 ha^{-1} was obtained from treatment G2P2 (90 ml plant growth regulator with 100 kg P_2O_5 ha^{-1}) with BCR of 1.64 and 1.70 indicating the economical yield of rice during 2004 and 2005, respectively. Reddy *et al*. (2009) found highest returns in terms of BCR values. The second highest net income was shown by the treatment G2P3 (90 ml plant growth regulator with 150 kg P_2O_5 ha^{-1}) that exhibited BCR of 1.32 and 1.37 during 2004 and 2005 respectively. The lowest net income was calculated in control treatment,

Table 1: Number of panicles m^{-2} as affected by plant growth regulator and phosphorus levels in transplanted coarse rice during 2004 and 2005

Phosphorus Levels	2004					2005				
	Plant Growth Regulator Levels					Plant Growth Regulator Levels				
	G_0	G_1	G_2	G_3	Means	G_0	G_1	G_2	G_3	Means
P_0	25.70^{A}	23.40^{B}	17.50^{JK}	22.40^{C}	22.25^{A}	22.00^{A}	21.00^{AB}	16.25^{JK}	20.50^{BC}	19.94^{A}
P_1	23.60^{B}	21.25^{E}	17.00^{K}	21.80^{D}	20.91^{B}	21.00^{AB}	20.25^{BCD}	16.00^{KL}	19.50^{CDEF}	19.19^{B}
P_2	21.00^{EF}	18.55^{I}	16.00^{L}	17.60^{J}	18.29^{D}	19.75^{CDE}	17.63^{HI}	15.00^{L}	17.25^{IJ}	17.41^{D}
P_3	20.75^{EF}	20.00^{GH}	17.60^{J}	20.50^{FG}	19.71^{C}	19.25^{DEFG}	18.50^{FGH}	16.50^{JK}	19.00^{EFG}	18.31^{C}
P_4	20.50^{FG}	19.70^{H}	17.90^{J}	20.70^{F}	19.70^{C}	19.20^{EFG}	18.35^{GH}	16.45^{JK}	18.85^{EFG}	18.21^{C}
Means	22.31^{A}	20.58^{B}	17.20^{C}	20.60^{B}		20.24^{A}	19.15^{B}	16.04^{C}	19.02^{B}	

LSD$_{0.01}$ =4.052 (G. Levels) LSD$_{0.01}$ =3.421 (G. Levels) LSD$_{0.01}$ =3.760 (Phosphorus Levels) LSD$_{0.01}$ =3.317 (Phosphorus Levels)
LSD$_{0.01}$ =7.521 (Interaction) LSD$_{0.01}$ =6.634 (Interaction)
Means followed by different letter(s) are significantly different at 1% level of probability using LSD test.

Table 2: Number of spikelets panicle^{-1} as affected by plant growth regulator and phosphorus levels in transplanted coarse rice during 2004 and 2005.

Phosphorus Levels	2004					2005				
	Plant Growth Regulator Levels					Plant Growth Regulator Levels				
	G_0	G_1	G_2	G_3	Means	G_0	G_1	G_2	G_3	Means
P_0	298.0^{N}	315.0^{LM}	340.0^{CDEF}	318.0^{KL}	317.8^{D}	300.0^{M}	316.0^{KL}	341.0^{CDE}	320.0^{JK}	319.3^{D}
P_1	310.0^{M}	325.0^{JK}	348.0^{B}	328.0^{HIJ}	327.8^{C}	312.0^{L}	326.0^{IJ}	349.0^{B}	330.5^{FGHI}	329.4^{C}
P_2	336.0^{DEFG}	346.0^{BC}	360.0^{A}	348.0^{B}	347.5^{A}	339.0^{DE}	347.0^{BC}	362.0^{A}	350.0^{B}	349.5^{A}
P_3	328.0^{HIJ}	335.0^{EFGH}	342.0^{BCDE}	333.0^{FGHI}	334.5^{B}	330.0^{GHI}	336.0^{EFG}	344.0^{BCD}	335.0^{EFGH}	336.3^{B}
P_4	327.0^{IJ}	336.0^{DEFG}	343.0^{BCD}	330.0^{GHIJ}	334.0^{B}	329.0^{HI}	337.0^{EF}	345.0^{BCD}	332.0^{FGHI}	335.8^{B}
	319.8^{C}	331.4^{B}	346.6^{A}	331.4^{B}		322.0^{C}	332.4^{B}	348.2^{A}	333.5^{B}	

LSD$_{0.01}$ =3.066 (G. Levels) LSD$_{0.01}$ =2.511 (G. Levels) LSD$_{0.01}$ =3.669 (Phosphorus Levels) LSD$_{0.01}$ =3.596 (Phosphorus Levels)
LSD$_{0.01}$ =7.337 (Interaction) LSD$_{0.01}$ =7.193 (Interaction)
Means followed by different letter(s) are significantly different at 1% level of probability using LSD test.

Table 3: Sterility percentage as affected by plant growth regulator and phosphorus levels in transplanted coarse rice during 2004 and 2005

Phosphorus Levels	2004					2005				
	Plant Growth Regulator Levels					Plant Growth Regulator Levels				
	G_0	G_1	G_2	G_3	Means	G_0	G_1	G_2	G_3	Means
P_0	109.0^{K}	128.0^{IJ}	148.0^{CDE}	130.0^{IJ}	128.8^{C}	112.0^{K}	130.0^{I}	148.0^{CD}	134.0^{GHI}	131.0^{D}
P_1	125.0^{J}	138.0^{FGH}	156.0^{B}	142.0^{EF}	140.3^{B}	120.0^{J}	138.0^{EFGH}	155.0^{BC}	142.0^{DEF}	138.8^{C}
P_2	142.0^{EF}	150.0^{BCD}	166.0^{A}	155.0^{BC}	153.3^{A}	140.0^{EFG}	153.0^{BC}	168.0^{A}	154.0^{BC}	153.8^{A}
P_3	131.0^{HIJ}	141.0^{EF}	154.0^{BC}	144.0^{DEF}	142.5^{B}	132.0^{HI}	142.0^{DEF}	156.0^{B}	$143.0^{\ DEF}$	143.3^{B}
P_4	133.0^{GHI}	145.0^{DEF}	150.0^{BCD}	140.0^{FG}	142.0^{B}	136.0^{FGHI}	144.0^{DE}	152.0^{BC}	137.0^{EFGH}	142.4^{B}
Means	128.0^{C}	140.4^{B}	154.8^{A}	142.2^{B}		128.0^{C}	141.4^{B}	155.8^{A}	142.1^{B}	

LSD$_{0.01}$ =0.07 (G. Levels) LSD$_{0.01}$ =0.21 (G. Levels) LSD$_{0.01}$ =0.25 (Phosphorus Levels) LSD$_{0.01}$ =0.52 (Phosphorus Levels)
LSD$_{0.01}$ =0.51 (Interaction) LSD$_{0.01}$ =1.04 (Interaction)
Means followed by different letter(s) are significantly different at 1% level of probability using LSD test.

Table 4: Normal kernels percentage as affected by plant growth regulator and phosphorus levels in transplanted coarse rice during 2004 and 2005

Phosphorus Levels	2004					2005				
	Plant Growth Regulator Levels					Plant Growth Regulator Levels				
	G_0	G_1	G_2	G_3	Means	G_0	G_1	G_2	G_3	Means
P_0	4.60^{L}	5.30^{JKL}	6.20^{EFGHI}	5.50^{IJK}	5.40^{D}	4.75^{I}	5.50^{GHI}	6.40^{DEF}	5.80^{FGH}	5.61^{D}
P_1	5.00^{KL}	6.00^{FGHIJ}	7.20^{CD}	6.30^{EFGH}	6.12^{C}	5.20^{HI}	6.02^{FG}	7.00^{CD}	6.20^{EFG}	6.11^{C}
P_2	6.70^{DEF}	7.50^{BC}	8.70^{A}	7.60^{BC}	7.62^{A}	6.90^{DE}	7.70^{BC}	8.90^{A}	7.80^{B}	7.82^{A}
P_3	5.60^{HIJK}	6.60^{DEF}	8.00^{AB}	6.40^{EFG}	6.65^{B}	5.58^{FGH}	6.82^{DE}	8.00^{B}	6.20^{EFG}	6.69^{B}
P_4	5.70^{GHIJK}	6.75^{DE}	7.60^{BC}	6.00^{FGHIJ}	6.51^{B}	5.90^{FGH}	6.90^{DE}	7.80^{B}	6.12^{EFG}	6.68^{B}
Means	5.52^{C}	6.43^{B}	7.54^{A}	6.36^{B}		5.70^{C}	5.59^{B}	7.62^{A}	6.42^{B}	

LSD$_{0.01}$ =3.039 (G. Levels) LSD$_{0.01}$ =2.178 (G. Levels) LSD$_{0.01}$ =2.553 (Phosphorus Levels) LSD$_{0.01}$ =3.199 (Phosphorus Levels)
LSD$_{0.01}$ =5.105 (Interaction) LSD$_{0.01}$ =6.398 (Interaction)
Means followed by different letter(s) are significantly different at 1% level of probability using LSD test.

Table 5: Paddy yield (t ha^{-1}) as affected by plant growth regulator and phosphorus levels in transplanted coarse rice during 2004 and 2005.

Phosphorus Levels	2004					2005				
	Plant Growth Regulator Levels					Plant Growth Regulator Levels				
	G_0	G_1	G_2	G_3	Means	G_0	G_1	G_2	G_3	Means
P_0	50.00^{K}	58.00^{IJ}	67.00^{FGH}	62.00^{HI}	59.25^{D}	52.00^{I}	60.00^{H}	69.00^{DEF}	64.00^{FGH}	61.25^{D}
P_1	56.00^{J}	68.00^{FG}	72.00^{DEF}	71.00^{EFG}	66.75^{C}	58.00^{HI}	70.00^{DEF}	74.00^{CDE}	73.00^{DE}	68.75^{C}
P_2	66.00^{GH}	77.00^{BCD}	88.00^{A}	78.00^{BC}	77.25^{A}	68.00^{EFG}	79.75^{BC}	87.00^{A}	80.00^{BC}	78.69^{A}
P_3	60.00^{IJ}	72.00^{DEF}	79.75^{B}	70.00^{EFG}	70.44^{B}	62.00^{GH}	73.00^{DE}	82.00^{AB}	72.00^{DE}	72.25^{B}
P_4	57.00^{IJ}	74.00^{CDE}	82.00^{B}	68.00^{FG}	70.25^{B}	58.00^{HI}	75.00^{CD}	84.00^{AB}	70.00^{DEF}	71.75^{BC}
Means	57.80^{C}	69.80^{B}	77.75^{A}	69.80^{B}		59.60^{C}	71.55^{B}	79.20^{A}	71.80^{B}	

$LSD_{0.01}$ =0.4046 (G. Levels) $LSD_{0.01}$ =0.3790 (G. Levels) $LSD_{0.01}$ =0.3673(Phosphorus Levels) $LSD_{0.01}$ =0.3967(Phosphorus Levels)
$LSD_{0.01}$ =0.7346 (Interaction) $LSD_{0.01}$ =0.7934 (Interaction)
Means followed by different letter(s) are significantly different at 1% level of probability using LSD test.

Table 6: Economic analysis and BCR in transplanted coarse rice as affected by plant growth regulator and phosphorus levels during 2004 and 2005

Plant growth regulator levels + Phosphorus levels	2004						2005					
	Paddy yield t ha^{-1}	Total variable cost Rs. ha^{-1}	Gross Income Rs. Ha^{1}	Total Cost Rs. ha^{-1}	Net Income Rs. ha^{1}	BCR	Paddy yield t ha^{-1}	Total variable cost Rs. ha^{-1}	Gross income Rs. ha^{1}	Total Cost Rs. ha^{-1}	Net Income Rs. ha^{1}	BCR
G_0 (0ml)	5.52	0	31990	16319	15641	0.95	5.7	0	33020	16319	16701	1.02
G_1 (60ml)	6.43	30	37130	16349	19531	1.10	6.59	30	38170	16349	20601	1.17
G_2 (90ml)	7.54	45	43290	16364	24441	1.29	7.62	45	43830	16364	25011	132
G_3 (120ml)	6.36	60	39580	16379	19481	0.96	6.42	60	37190	16379	17121	0.85
P_0 (0 kg ha^{-1})	5.4	0	31990	16319	15641	0.91	5.61	0	32600	16319	11281	0.52
P_1 (50 kg ha^{-1})	6.12	1250	35280	17569	17711	1.00	6.11	1250	35490	17569	19141	1.17
P_2 (100 kg ha^{-1})	7.62	2500	43850	18819	25031	1.33	7.82	2500	45010	18819	27411	1.55
P_3 (150 kg ha^{-1})	6.65	3750	38315	20069	18246	0.90	6.69	3750	38665	20069	19816	1.05
P_4 (200 kg ha^{-1})	6.51	5000	37600	21319	16281	0.76	6.68	5000	38555	21319	18456	0.91
G_0 X P_0	4.6	0	26750	16319	10431	0.63	4.75	0	27650	16319	11331	0.69
G_0 X P_1	5	1250	29100	17569	11531	0.65	5.2	1250	30250	17569	12681	0.72
G_0 X P_2	6.7	2500	38650	18819	19831	1.05	6.9	2500	39850	18819	21031	1.11
G_0 X P_3	5.6	3750	32450	20069	12381	0.61	5.58	3750	32500	20069	12431	0.61
G_0 X P_4	5.7	5000	33000	21319	11681	0.54	5.9	5000	34010	21319	12691	0.59
G_1 X P_0	5.3	30	30850	16349	14501	0.88	5.5	30	32300	16349	15951	0.97
G_1 X P_1	6	1280	34700	17599	17101	0.97	6.02	1280	35350	17599	17751	1.00
G_1 X P_2	7.5	2530	43200	18849	24351	1.29	7.7	2530	44300	18849	25451	1.35
G_1 X P_3	6.6	3780	38000	20099	17901	0.89	6.82	3780	39400	20099	19301	0.96
G_1 X P_4	6.75	5030	38900	21349	17551	0.82	6.9	5030	39700	21349	18351	0.85
G_2 X P_0	6.2	45	35900	16364	19536	1.19	6.4	45	37100	16364	20736	1.26
G_2 X P_1	7.2	1295	41350	17614	23736	1.31	7	1295	40500	17614	22886	1.29
G_2 X P_2	8.7	2545	49850	18864	30986	1.64	8.9	2545	51100	18864	32236	1.70
G_2 X P_3	8	3795	45700	20114	25586	1.27	8	3795	45700	20114	25586	1.27
G_2 X P_4	7.6	5045	43650	21361	22289	1.04	7.8	5045	44750	21361	23389	1.09
G_3 X P_0	5.5	60	31750	16379	15371	0.93	5.8	60	33400	16379	17021	1.03
G_3 X P_1	6.3	1310	36100	17629	18471	1.04	6.2	1310	35750	17629	18121	1.02
G_3 X P_2	7.6	2560	43800	18879	24921	1.32	7.8	2560	44900	18879	26021	1.37
G_3 X P_3	6.4	3810	37100	20129	16971	0.84	6.2	3810	36250	20129	16121	0.80
G_3 X P_4	6	5060	34900	21379	13521	0.63	6.12	5060	35750	21379	14371	0.67

where neither plant growth regulator was applied nor phosphatic fertilizer was applied.

Conclusion: It has been observed from the preceded discussion that various levels of plant growth regulator and phosphatic fertilizer significantly affected the yield as well as yield contributing parameters of transplanted rice during both the years of study. The two factors best interacted at the levels of 90 ml NAA and 100 kg P_2O_5 ha^{-1} with each other by putting a beneficial effect on the yield attributes and BCR. It is, therefore, recommended that NAA @ 90 ml ha^{-1} with 100 kg P_2O_5 ha^{-1} is the best combination for economical yield and BCR enhancement in transplanted rice.

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