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Original Research Article

Interaction Effect of Nitrogen and Phosphorus Levels on Yield and Quality of Baby Corn

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A B S T R A C T

An experiment entitled "Effect of nitrogen and phosphorus levels on yield and quality of baby corn" was carried out in *kharif* season of 2014-15 at the Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.). The experiment was laid out in Factorial Randomized Block Design with three replications and twelve treatment combinations with factor A *viz*. nitrogen(N) i.e. 150 kg ha^{-1} (N_1), 175 kg ha^{-1} (N_2), 200 kg ha^{-1} (N_3) and 225 kg ha^{-1} (N_4) factor B phosphorus (P) i.e. 50 kg ha^{-1} (P_1), 75 kg ha^{-1} (P_2) and 100 kg ha^{-1} (P_3).Yield and quality parameters were significantly influenced by nitrogen levels, treatment with application of nitrogen 200 kg ha^{-1} recorded significantly higher. Number of cob per plant, cob length, cob diameter, cob weight with and without husk also significantly influenced by N_3 (200 kg ha^{-1}) levels of nitrogen application. Quality parameters like protein and sugar was also significantly influenced by N_4 (225 kg/ha) level of application. Cob length, cob weight, cob yield per hectare, sugars (%), total dry matter accumulation, plant height was recorded significantly higher at P_3 (100 kg ha^{-1}) level of application. Minimum days to 50% silking was recorded at P_1 (50 kg ha^{-1}) level of application. Whereas higher protein was recorded at P_2 (75 kg ha^{-1}) level of application. Application of phosphorus had also significant effect on various yield and quality parameters. The maximum plant height, number of leaves was recorded in P_3 level of phosphorus application (100kg P_2O_5 kg^{-1}). Among all the treatment combination of nitrogen and phosphorus the interaction level of N_3P_3 (200kg+100kg N: P_2O_5 kg^{-1}) had recorded maximum yield parameters.

Keywords

Babycorn, Cultivar, Nitrogen, Phosphorus Yield

Introduction

Vegetables are rich sources of vitamins, mineral and dietary fiber essential for functioning of human body and very common in human diet that a meal without vegetable is supposed to be incomplete in any part of the world. Maize (*Zea mays* L.) also known as "Queen of Cereals" belongs to family Graminae and is the third most important cereal crop next to rice and wheat and having highest production potential among the cereals. For diversification and value addition of maize as well as growth of food processing industries. Young cob corn has a short growth thus a farmer can grow four or more crop cycles per year. It has a wide range of adaptation and does not need intensive cultivation. Considering these factors, young cob corn has good potential. Baby corn production, being a recent development has proved an enormously successful venture in countries like Thailand and Taiwan. Attention is now being paid to explore its potential in India, for earning foreign exchange besides higher economic

returns to the farmers. Baby corn production being a recent development has proved an enormously successful venture in countries like Thailand and Taiwan.

It is cultivated on nearly 150 million ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36 % (782 mt) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35 % of the total production in the world highest productivity (>9.6 t ha^{-1}).Whereas, the average productivity in India is 2.43 t ha^{-1}. It is estimated the maize was cultivated on 8.7 million ha area (2010-11) and mainly during *kharif* season. The final estimates of 2014-15 have indicated an increase in of maize production over last two years and it has touched 24.35 million tonnes, which is the highest so far in the history of maize production in India. The trends in last three years indicate that area under maize cultivation expanding not only in *rabi* but also *kharif* season. For the major processes of plant development, the presence of nutrient element like nitrogen, phosphorus, potassium, sulphur, magnesium etc in balanced form is essential as given by (Colomb *et al.,* 2000), (Randhawa and Arora, 2000). Maize is an exhaustive crop requires all types of macro and micro nutrients for better growth and yield potential. Among the various nutrients, nitrogen is the principal of better harvest and requires approximately 150 N_2O kg ha^{-1}. Nitrogen is a primary plant nutrient that plays a major role in achieving the maximum economic yields from production. Nitrogen is an essential constituent of proteins, nucleic acids, vitamins and many other organic molecules such as chlorophyII. Nitrogen also forms a constituent of various hormones, coenzymes and ATP. Nitrogen is added to soil through inorganic and organic sources. The chemical fertilizers contain concentrated nitrogen and widely used to meet the demand of high yielding crop varieties. In these fertilizers, N is present as either NH_4^+, NO_3^- or both or as amide (NH_2^-). Some of the nitrogen containing fertilizers is ammonium sulphate (20.6% nitrogen). Similarly adequate supply of phosphorus encourages root growth and enhances maturity. Phosphorus promotes healthy root growth and fruit ripening. It makes about 0.2% of the nutrient. No other element can be substituted for it. It is utilized in large quantity by plants.

Materials and Methods

Experimental Site

The experiment entitled, "Effect of nitrogen and phosphorus levels on yield and quality of baby corn" was carried out at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *kharif* season of 2015.

Akola is situated in subtropical region between 22.42°N latitude and 77.02° E longitude at an altitude of 307.42 m above the mean sea level. The climate of Akola is semi-arid and characterized by three distinct seasons i.e. hot and dry summer from March to May, warm humid and rainy monsoon from June to October and mild cold winter from November to February. The meteorological data in respect of rainfall, humidity, maximum and minimum temperature for the period of experimentation recorded at Meteorological section Department of Agronomy, Dr. Panjabrao Krishi Vidyapeeth, Akola in 2015 (Appendix I). Fairly leveled land was selected for conducting the experiment. The experimental plot was with very loose soil having uniform texture and structure with good drainage.

Materials and Methods

The experiment was laid out in factorial randomized block design with three replications and treatments were consisting of twelve combinations of four levels of nitrogen four nitrogen levels viz.150 kg N - 1, 175 kg N ha-1, 200 kg N ha-1,225 kg N ha-1 and three levels of phosphorus viz. 50 kg P ha-1, 75kgP ha-1,100 kg P ha-1. The crop was baby corn with variety G-5414 and number of plot thirty six. Statistical analysis of the data was carried out using standard analysis of variance.

Results and Discussion

Yield attributes

Among the yield attributes (number of cob per plant, cob yield per plant, per plot, per hectare) the data in respect of maximum yield was recorded with treatment combination N_3P_3 (200kg +100 kg N: P_2O_5 ha $^{-1}$).

Dry yield ton ha^{-1}as influenced by nitrogen levels was found to be significant. Maximum dry yield (4.89 t/ha) was recorded in P_3 (100 kg P_2O_5/ha). Whereas, minimum dry yield (4.69 t/ha) was recorded in P_1 (50 kg P_2O_5ha^{-1}). The results of present investigation are in similar line as finding obtained by Bindhani *et al.,* (2008) and Keerthi *et al.,* (2013).

The interaction effects of nitrogen and phosphorus levels on cob weight with husk was found significant. Maximum cob weight with husk (50.34 g) was recorded in treatment combination N_4P_3 (225kg + 100 kg ha^{-1}), and minimum (38.30 g) was recorded at N_1P_2 (150 kg ha^{-1}+75 kg N: P_2O_5 ha^{-1}), the similar findings have also been reported by Singh *et al.,* (2010) in baby corn. The interaction effects of nitrogen and phosphorus levels on cob weight without husk were found significant. Maximum cob weight without husk (9.59 g) was recorded in treatment combination N_3P_2 (200 kg+ 75 kg N:P_2O_5 ha^{-1}),which was at par with N $_3P_1$,N $_4P_1$,N$_4$ P_2,N $_2P_3$,N $_3P_3$,N $_4P_3$ and minimum was recorded (7.47 g) at N_1P_1 (150 kg ha^{-1}+ 50 kg ha^{-1}). The data regarding interaction effects are presented in Table 15. The interaction effect between nitrogen and phosphorus levels on cob yield per plant with husk was found significant. Maximum yield (136.95 g) was recorded in treatment combination N_3P_3 (200 kg +100 kg N: P_2O_5 ha^{-}) and minimum yield was recorded (116.92 g) at N_1P_1 (150 kg+50 kg N: P_2O_5 ha^{-1}). The interaction effects between nitrogen and phosphorus levels on cob yield per plant without husk was found significant. Maximum yield (25.63 g) was recorded in treatment combination N_3P_3 (200 kg +100 kg N: P_2O_5 ha^{-1}) which was at par with N_2P_2, N_4P_1, N_4P_2 and N_4P_3 and minimum yield was recorded (17.48 g) at N_1P_1. (150 kg+50 kg N: P_2O_5 ha^{-1}). The results of present investigation are in similar to finding obtained by Singh *et al.,* (2010). The interaction effect between nitrogen and phosphorus levels on cob yield per plot with husk (kg) was found significant. Maximum yield (7.83 kg) was recorded in treatment combination N_3P_3 (200kg+100kg N: P_2O_5ha^{-1}) which was at par with N_4P_2 (7.56kg) and minimum yield was recorded (6.50 kg) at N_1P_1 (150 kg +50 kg N: P_2O_5 ha^{-1}). The interaction effects between nitrogen and phosphorus levels on cob yield per plot without husk (kg) was found significant. Maximum yield (1.89 kg) was recorded in treatment combination N_3P_3 (200 kg +100 kg N: P_2O_5 ha^{-1}) and minimum yield was recorded (1.03 kg) at N_1P_1 (150 kg+50 kg N: P_2O_5 ha^{-1}). The results of present investigation are in similar line as finding obtained by Singh *et al.,* (2010) in baby corn.

Table.1 Effect of different levels and nitrogen and phosphorus on yield and quality of baby corn

Treatments	Cob yield per plant (g without husk).	Cob yield per plot (kg without husk)	Cob yield per hectare without husk (q ha^{-1})	Green fodder yield (t ha^{1})	Dry yield (t ha^{-1})	No of cobs/plant	Cob weight with husk (g)	Cob weight out husk (g)
A.Nitrogen (kg ha^{1})								
N_1 – 150	19.22	1.32	44.95	33.58	4.30	2.44	38.67	7.78
N_2 – 175	23.47	1.44	48.25	39.41	4.47	2.57	43.21	8.91
N_3 – 200	22.56	1.46	54.21	41.82	5.16	2.80	47.26	9.53
N_4 – 225	24.57	1.41	58.36	40.33	5.32	2.69	46.72	9.47
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)+	0.47	0.04	0.51	0.19	0.06	0.07	0.38	0.05
CD at 5%	1.97	0.13	1.49	0.57	0.19	0.21	1.12	0.16
B. Phosphorus (kg ha$^{-1)}$								
P_1– 50	21.84	1.24	49.41	37.99	4.69	2.52	42.56	8.66
P_2 – 75	22.60	1.38	50.90	39.56	4.86	2.53	42.42	8.97
P_3 – 100	24.39	1.46	54.02	38.81	4.89	2.83	45.92	9.13
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)+	0.36	0.04	0.44	0.17	0.06	0.06	0.33	0.05
CD at 5%	1.07	0.11	1.29	0.49	0.16	0.18	0.97	0.14

Table.2 Effect of different levels and nitrogen and phosphorus on yield and quality of baby corn

Treatment combination	Cob yield per plant(g without husk)	Cob yield per plot(kg without husk)	Cob yield per hectare without husk (q ha^{-1})	Green fodder yield(t ha^{1})	Dry yield (t ha^{-1})	No of cobs/plant	Cob weight with husk(g)	Cob weight out husk(g)
N_1×P_1	17.48	1.03	43.54	33.36	4.38	2.33	38.52	7.47
N_1×P_2	18.51	1.34	45.58	33.14	4.32	2.46	38.30	7.56
N_1×P_3	21.66	1.33	45.73	34.25	4.22	2.53	39.19	8.31
N_2×P_1	23.40	1,27	46.43	35.36	4.34	2.36	39.00	8.22
N_2×P_2	24.61	1.36	47.85	41.51	4.43	2.53	45.30	9.18
N_2×P_3	22.41	1.33	50.47	41.37	4.66	2.83	45.33	9.33
N_3×P_1	22.59	1.35	51.04	41.35	4.72	2.76	45.41	9.54
N_3×P_2	22.44	1.26	51.25	41.69	5.30	2.30	47.80	9.59
N_3×P_3	25.63	1.89	60.33	34.41	5.44	3.30	48.58	9.46
N_4×P_1	24.34	1.42	56.62	41.85	5.33	2.63	47.33	9.41
N_4×P_2	24.44	1.54	58.91	41.88	5.37	2.79	46.26	9.57
N_4×P_3	24.92	1.53	59.53	37.23	5.25	2.66	50.34	9.43
'F' test	Sig	Sig	Sig	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)+	0.47	0.03	0.97	0.33	0.11	0.12	0.66	0.9
CD at 5%	1.37	0.08	2.84	0.98	0.32	0.36	1.95	0.27

Table.3 Effect of different levels and nitrogen and phosphorus on yield and quality of baby corn

Treatment combinations	Fiber (%)	Moisture (%)	Reducing sugar (%)	Non reducing sugar	Total sugar (%)	Protein (%)
A.Nitrogen (kg ha^{1})						
N_1×P_1	5.03	86.77	0.27	2.45	2.61	14.90
N_1×P_2	5.45	87.00	0.29	2.23	2.83	15.55
N_1×P_3	5.53	87.00	0.34	2.61	2.63	15.63
N_2×P_1	5.36	86.00	0.41	2.65	2.96	15.80
N_2×P_2	5.46	88.00	0.45	2.28	2.28	16.20
N_2×P_3	5.48	88.00	0.43	2.40	3.16	14.39
N_3×P_1	5.45	89.17	0.36	2.53	3.63	15.80
N_3×P_2	5.53	88.86	0.49	2.80	3.66	16.83
N_3×P_3	5.71	87.34	0.46	2.45	2.95	16.70
N_4×P_1	5.56	89.06	0.48	2.55	3.46	16.80
N_4×P_2	5.26	90.11	0.51	2.46	3.75	16.66
N_4×P_3	5.51	90.07	0.57	2.70	3.09	16.35
'F' test	Sig.	Sig.	NS	Sig.	Sig.	Sig.
SE(m)+	0.08	0.16	0.01	0.04	0.12	0.28
CD at 5%	-	0.46	-	0.12	0.35	0.81

Treatment details

Sr. No.	Treatment combination
1	N_1P_1 - 150 kg + 50 kg N:P_2O_5ha^{-1}
2	N_1P_2 - 150kg + 75kg N:P_2O_5ha^{-1}
3	N_1P_3 - 150 kg + 100 kg N:P_2O_5ha^{-1}
4	N_2P_1 - 175 kg + 50 kg N:P_2O_5ha^{-1}
5	N_2P_2 - 175 kg + 75 kg N:P_2O_5ha^{-1}
6	N_2P_3 - 175 kg + 100 kg N:P_2O_5ha^{-1}
7	N_3P_1 - 200 kg +50 kg N:P_2O_5ha^{-1}
8	N_3P_2 - 200 kg +75 kg N:P_2O_5ha^{-1}
9	N_3P_3 - 200 kg +100 kg N:P_2O_5ha^{-1}
10	N_4P_1 - 225 kg +50 kg N:P_2O_5ha^{-1}
11	N_4P_2 - 225 kg +75 kg N:P_2O_5ha^{-1}
12	N_4N_3 - 225 kg +100 kg N:P_2O_5ha^{-1}

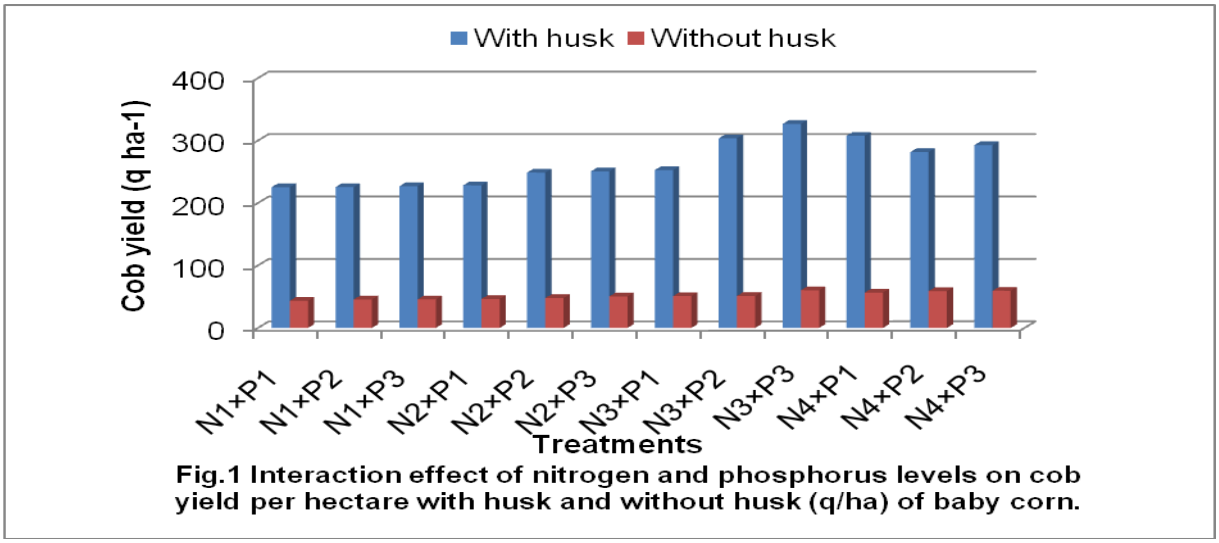

Fig.1 Interaction effect of nitrogen and phosphorus levels on cob yield per hectare with husk and without husk (q/ha) of baby corn.

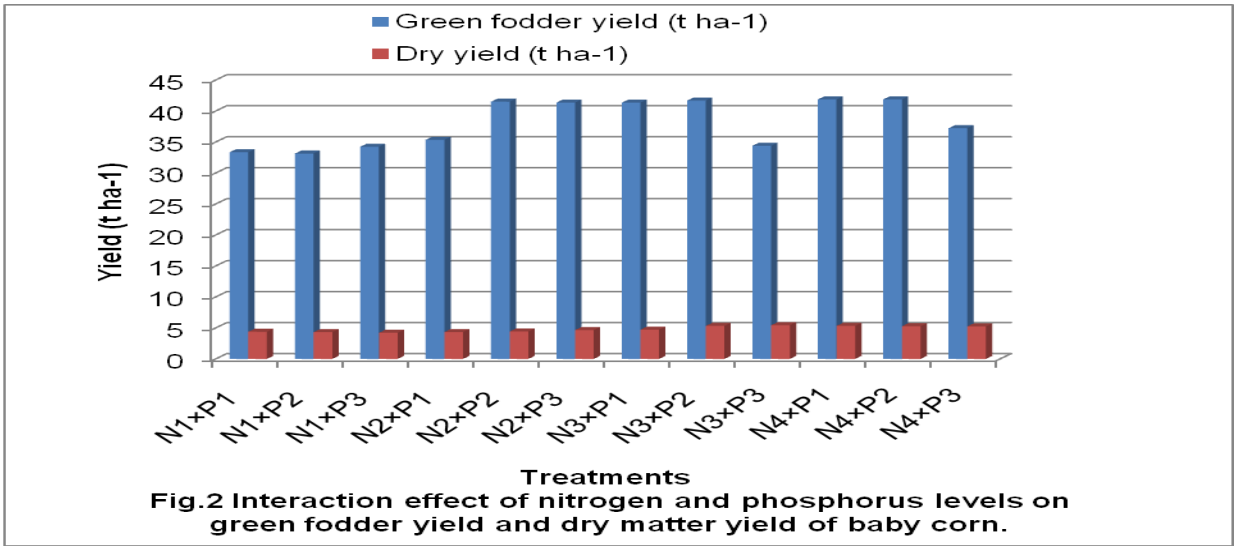

Fig.2 Interaction effect of nitrogen and phosphorus levels on green fodder yield and dry matter yield of baby corn.

The interaction effects between nitrogen and phosphorus levels on cob yield per hectare with husk (q/ha) was found significant. Maximum yield (326.60 q) was recorded in treatment combination N_3P_3 (150kg + 50kg N: P_2O_5 ha^{-1}), which is at par with N_4P_3 and minimum yield was recorded (225.40 q) at N_1P_1 (150 kg + 50 kg N: P_2O_5 ha^{-1}). Maximum yield (60.33 q) was recorded in treatment combination N_3P_3 which was at par with N_4P_2, N_4P_3 (58.91, 59.53 respectively) and minimum yield was recorded (43.54 q) at N_1P_1. (150 kg + 50 kg N: P_2O_5 ha^{-1}). The interaction effects between nitrogen and phosphorus levels on green fodder yield (t ha^{-1}) were found statistically significant. Maximum green fodder yield (41.88 t) was recorded in treatment combination N_4P_2 (225 kg+75 kg ha^{-1}), which was at par with treatment N_4P_1, N_2P_2, N_3P_3, N_2P_3 However, minimum (33.14 t) was recorded at N_1P_2 (150 kg ha^{-1}+75 kg N: P_2O_5 ha^{-1}). The results of present investigation are in similar line as finding obtained by Thavaprakash *et al.,* (2008) and Hooda *et al.,* (2013).

Quality parameters

The interaction effects between nitrogen and phosphorus levels on moisture content (%) were found significant. Maximum moisture content (90.11 %) was recorded in treatment combination N_4P_2 (225 kg +200 kg N: P_2O_5 ha^{-1}) whereas, minimum (86.00 %) was recorded at N_2P_1 (175 kg +50 kg N: P_2O_5 ha^{-1}). The interaction effects between nitrogen and phosphorus levels on reducing sugar (%) was found non-significant. The interaction effects between nitrogen and phosphorus levels on non-reducing sugar (%) were found significant. Maximum non-reducing sugar content (2.80 %) was recorded in treatment combination N_3P_2 (300 kg+75 kg N: P_2O_5 ha^{-1}). Whereas, minimum (2.23%) was recorded at N_1P_2 (150 kg+75 kg N: $P_2O_5ha^{-1}$). The interaction effects between nitrogen and phosphorus levels on total sugar (%) were found significant. Maximum total sugar content (3.75 %) was recorded in treatment combination N_4P_2 which was at par with N_3P_1, N_3P_2, N_4P_1, (3.63, 3.66 and 3.46 respectively) Whereas, minimum (2.61 %) was recorded at N_1P_1 (150 kg +50 kg N:P_2O_5 ha^{-1}). The results of present investigation are in similar line as finding obtained by Singh *et al.,* (2010) Sahoo *et al.,* (2011).

The interaction effects between nitrogen and phosphorus levels on protein content (%) was found statistically significant. Maximum protein content (16.83%) was recorded in treatment combination N_3P_2 (200 kg +75 kg N: P_2O_5 ha^{-1}) which was at par with N_2P_2, N_3P_3, N_4P_1, N_4P_2, N_4P_2 (16.20, 16.70, 16.80, 16.66, 16.80 respectively) whereas, minimum (14.39 %) was recorded at N_2P_3 (200 kg +100 kg N: P_2O_5 ha^{-1}). Among the quality parameters the data in respect of maximum protein percentage was significantly affected by different treatments.

The significantly maximum value of protein percent (16.83%) was recorded with treatment combination N_3P_2 (200kg +75 kg N: P_2O_5ha $^{-1}$). Protein content as influenced by different levels of nitrogen was found significant. However, maximum protein content (16.61) was recorded in N_4 (225kgNha^{-1}). Whereas, minimum protein (15.36) was recorded in N_1 (150 kg N ha^{-1}). Maximum protein content (16.31) was recorded in P_2 (75 kg P_2O_5/ha) whereas, minimum protein content (15.83) was recorded in P_3 (100 kg P_2O_5/ha).Fiber, reducing sugar influenced by different levels of nitrogen, phosphorus was found non-significant effect. The results are in conformity with those of Kumar *et al.,* (2007), Bunker *et al.,* (2013) in baby corn.

Number of cob per plant, cob weight with and without husk also significantly influenced by N_3 (200 kg ha^{-1}) levels of nitrogen application. Quality parameters like protein and sugar was also significantly influenced by N_4 (225 kg/ha) level of application. cob weight, cob yield per hectare, sugars (%), Whereas higher protein was recorded at P_2 (75 kg ha^{-1}) level of application.

Application of phosphorus had also significant effect on various yield and quality parameters. Among all the treatment combination of nitrogen and phosphorus the interaction level of N_3P_3 (200kg+100kg N: P_2O_5 kg^{-1}) had recorded maximum yield parameters.

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