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Effect of foliar spray of Urea and NAA on the growth and yield of ginger (*Zingiber officinale* Roscoe)

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Abstract

A field study was conducted at Department of Horticulture Kulbhaskar Ashram P.G. College, Allahabad during 2016 and 2017 to study the effect of foliar spray of urea and NAA on the growth and yield of ginger. Healthy and disease free ginger rhizomes were select and used for planting. The rhizomes were then, cut into small pieces of about 15 gm. weights and planted at spacing of 25x20 cm. The experimental was conducted in Factorial Randomized block design with Twelve treatments replication thrice. 180 days after sowing that variety V₁ (Baruwa Sagar, 57.54 and 58.09 cm) maximum height than the variety V₂ (Rio-de-Janeiro, 56.17 and 56.34 cm.) in both the years that the data also showed that the application of urea as foliar spray increase the plant height. Significantly both years. In respect of doses of NAA, 400 PPM was (N₂) height of 59.69 and 59.81 cm. both the years and next dose of 200 PPM (N₁) maximum height 57.11 and 57.84 cm. as compared to 53.75 and 54.01 cm. in N₀ in both year. Thickness of main stem at 180 days that variety V₁ (Baruwa Sagar, 0.895, 0.896 and 0.895 cm.) was superior to variety V₂ (Rio-de-Janeiro, 0.881, 0.864 and 0.872 cm.) in respect of thickness in first year, second year and in pooled mean. It was also found application of urea in both the years and pooled analysis. It was further observed that there was maximum thickness in N₂ (NAA 400 PPM, 0.911 cm) which was at Par with N₁ (NAA 200 PPM, 0.901 cm.) and minimum in N₀ (NAA 0 PPM, 0.852 cm.) in the first year however, in the second year. Number of tillers at 180 days that the variety V₁ Baruwa Sagar as 13.62, 13.18 and 13.40 was superior than variety V₂ Rio-de-Janerio recording 13.17, 12.93 and 13.04 Number per plant in the first and second year and in pooled analysis, respectively. it was also found application of Urea in both the years. The data furthe showed that treatment N₂ (NAA 400 PPM) produced maximum number of tillers an 13.78 per plant, which was as good as to N₁ (NAA 200 PPM) recording 13.40 number of tillers per plant in the first year. However, in the second year N₂ was significantly superior by showing 13.82 number of tillers as compared to 13.40 and 11.95 per plant in N₁ and N₀, respectively. Yield per Plant of ginger that the variety V₁ (Baruwa Sagar) was significantly superior to variety V₂ (Rio-de-Janeiro) in both the years and in pooled analysis. The data showed that there was maximum plant yield with the application of N₂ (NAA 400 PPM) followed by N₁ (NAA 200 PPM) and minimum in N₀ (NAA 0 PPM) in both the years as well as in pooled mean. The maximum value was 151.97 gm. in the first year in N₂, 149.67 gm. in the second year and 150.82 gm per plant in the pooled mean. Similarly, the application of Urea 2 per cent also produced the higher yield to the tune of 150.68, 148.20 and 149.44 gm. per plant respectively in the first year, second year and in pooled mean. Yield per hectare that variety V₁ (Baruwa Sagar) sagar significantly superior to variety variety V₂ (Rio-de-Janerio) in both the years as well as pooled mean. That yield values were 286.02, 277.32, 281.66 q/ha in first year second year and pooled mean, respectively. The application of urea also showed significantly increase in yield in both the years as well as in pooled mean. Similarly, the N₂ (NAA 400 PPM) gave the maximum followed by N₁ (NAA 200 PPM) and N₀ (NAA 0 PPM) to the tune of 301.39, 299.03 and 300.21, 287.36, 284.03 and 265.69 and 235.56, 244.03 and 258.42 q/ha in first year second year and pooled mean respectively.

Keywords: Ginger, Urea, NAA foliar spray

1. Introduction

Ginger (*Zingiber officinale*, Roscoe) occupies an important spice crop of our country. It belongs to the family Zingiberaceae. it is believed to be a native of Tropical Asia.

Botanically ginger is the rhizome or the underground modified stem. it is a herbaceous perennial but commercially cultivated as an annual crop. The ginger of commerce is the dry product of the green underground stem or rhizome, which is valued as a spice. Of late, new uses have been found through aleoresin ginger, essential oils and dehydrated powder etc.

ginger is used in various medicinal and culinary preparations. The significance of ginger is the form of preserves and confectionaries cannot be ignored. it is also used in the preparation of ginger wine, ginger bear, ginger carbonated water etc. Pickled in salt is largely used in Indian homes. In addition, it is used in the preparation of tincture ginger, gongoal gingerine, digestive

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tablets, honey ginger, powder ginger and dry ginger. It is also used for the extraction of essential oil gingerol.

In the spice trade, the dry ginger is the major item. Dry ginger contain moisture 69 per cent, protein 8.6 per cent, fat 6.4 per cent, fibre 5.9 per cent, ash 5.7 per cent, minerals and vitamin like A, B and C 380 calories/ 100 g.

In India about 70 per cent of the total ginger production is confined to Kerala state alone which also produces the best quality ginger. Nearly one third of the total production is exported, the rest being consumed locally for various purposes.

It requires a warm and humid climate. The crop can thrive well in sandy or clayey loam, red loam or lateritic loam soils. To obtain maximum from the soil with better quality of rhizomes, emphasis should be given on the proper use of fertilizers as it serves one of major factor in crop production especially in spices cultivation. Even the prolific strains may not yield their maximum unless they are grown under the optimum conditions of soil fertility.

In several crops, foliar application at lower levels of fertilizers especially urea gives better yield as compared to soil application of a higher level of fertilizers. Besides, it also helps in improving the quality of the produce. But, in India a very little work has been done on ginger.

The use of growth substance like NAA for improving the growth and development as well as yield have been reported in different crops of vegetables, but no such work has been done in case of ginger.

Rio-de-Janeiro is an important cultivar which was introduced in India as a heavy yielder having more pungency with less fibre content. The local variety Baruwa Sagar is popular one among the farmers because of its large area under cultivation. Under the above background a field trial was undertaken to assess the performance of improved varieties like Rio-de-

Janeiro and Baruwa Sagar with single and mixed application of Urea and NAA. To study the effect of growth and yield of ginger (*zingiber officinale* Roscoe).

Materials and Methods

The experiment was laid out in the Department of Horticulture at Kulbhaskar Ashram Post Graduate College, Allahabad during 2016 and 2017 to study the Effect of foliar spray of urea and NAA on the growth and yield of ginger. The experiment was conducted in Factorial Randomized Block Design in three replications involving twelve treatments comprising two levels of urea (U₀ -0% & U₁-2%), three levels of NAA (N₀ – 0 PPM, N₁-200 PPM & N₂ -400 PPM) and two varieties (V₁-Barua Sagar and V₂- Rio-de-Jeneiro). The district of Allahabad lies between 40°75'-25°-85'N north latitude and 81°-20' - 82°-55' East longitude in Uttar Pradesh and situated at about 97.0 metres above the sea level. It forms a representative part of the Upper Gangetic plain. It comes under the climatic type C₁ i.e., "Dry Sub-humid climate" showing an extreme low and high temperature during winter and summer months, respectively. The rain usually start in the latter half of June and remain during the month of July to September after a long spell of summers. The mean monthly values of weather conditions for the period of investigations recorded at the meteorological observatory Allahabad. The surface soil upto 22.5 cm. depth of the experimental plot was sampled from five places selected at randomly before planting of rhizome to form a composite sample. Such samples collected for both the years were chemically analyzed. The soil was sandy loam in texture and was quite favourable for plant growth. The soil reaction was almost neutral having fairly uniform fertility status in both the years.

Table 1: Plant Height at 180 Days (cm)

V x U

Treatments							Combined		
	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
V ₁	55.91	59.16	57.54	56.44	59.74	58.09	56.18	59.45	57.81
V ₂	54.12	58.21	56.17	54.15	58.54	56.34	54.14	58.37	56.25
Mean	55.02	58.68	56.85	55.30	59.14	57.22	55.16	58.91	57.03

V x N

Treatment	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean
V ₁	54.45	57.70	60.46	57.54	54.63	58.59	61.06	58.09	54.54	58.14	60.76	57.81
V ₂	53.06	56.53	58.92	56.17	53.39	57.09	58.56	56.34	53.22	56.81	58.74	56.25
Mean	53.75	57.11	59.69	56.85	54.01	57.84	59.81	57.22	53.88	57.47	59.75	57.03

N x U

Treatments	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
N ₀	52.03	55.48	53.75	52.15	55.87	54.01	52.09	55.67	53.88
N ₁	55.63	58.60	57.11	56.05	59.62	57.84	57.54	61.95	59.75
N ₂	57.40	61.98	59.69	57.69	61.93	59.81	55.16	58.91	57.47
Mean	55.02	58.68	56.85	55.30	59.14	57.22	55.16	58.91	57.03

Standard Error and Critical Difference

Comparison between means of	S.E.(M) +	C.D. at 5%	S.E. (M) +	U.E. (M) +	S.E.(M) +	C.D. at 5%
V	0.2261	0.6631	0.3262	0.9567	0.1972	0.5617
U	0.2261	0.6631	0.3262	0.9567	0.1964	0.5595
N	0.2769	0.8122	0.3994	1.1716	0.2400	0.6832
VU	0.3198	-	0.4613	-	0.2777	-
VN	0.3917	-	0.5651	-	0.3387	-

UN	0.3917	-	0.5651	-	0.3380	-
VUN	0.5539	-	0.7990	-	0.4886	-

Table 2: Mean Thickness of Main Stem at 180 Days (cm)

V x U

Treatments							Combined		
	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
V ₁	0.884	0.905	0.895	0.884	0.907	0.896	0.884	0.906	0.895
V ₂	0.868	0.893	0.881	0.842	0.886	0.864	0.855	0.890	0.872
Mean	0.876	0.899	0.888	0.863	0.897	0.880	0.870	0.898	0.884

V x N

Treatment	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean
V ₁	0.862	0.907	0.916	0.895	0.864	0.907	0.916	0.896	0.863	0.907	0.916	0.895
V ₂	0.843	0.895	0.905	0.881	0.821	0.871	0.900	0.864	0.832	0.883	0.903	0.872
Mean	0.852	0.901	0.911	0.888	0.842	0.889	0.908	0.880	0.847	0.895	0.909	0.884

N x U

Treatments	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
N ₀	0.834	0.870	0.852	0.819	0.866	0.842	0.827	0.868	0.847
N ₁	0.894	0.908	0.901	0.872	0.906	0.889	0.883	0.907	0.895
N ₂	0.902	0.920	0.911	0.898	0.918	0.908	0.899	0.919	0.909
Mean	0.876	0.899	0.888	0.863	0.897	0.880	0.870	0.898	0.884

Standard Error and Critical Difference

Comparison between means of	S.E.(M) +	C.D. at 5%	S.E. (M) +	U.E. (M) +	S.E.(M) +	C.D. at 5%
V	0.0028	0.0081	0.0032	0.0093	0.0063	-
U	0.0028	0.0081	0.0032	0.0093	0.0022	0.0062
N	0.0034	0.0099	0.0040	0.0116	0.0026	0.0074
VU	0.0040	-	0.0045	0.0133	0.0030	0.0089
VN	0.0048	-	0.0056	-	0.0037	-
UN	0.0048	-	0.0056	-	0.0037	0.0105
VUN	0.0068	-	0.0078	-	0.0052	-

Table 3: Mean Number of Tillers per plant at 180 Days

V x U

Treatments							Combined		
	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
V ₁	13.70	13.53	13.62	12.80	13.57	13.18	13.25	13.55	13.40
V ₂	13.00	13.33	13.17	12.47	13.39	12.93	12.73	13.36	13.04
Mean	13.35	13.43	13.39	12.63	13.48	13.06	12.99	13.46	13.22

V x N

Treatment	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean
V ₁	13.35	13.65	13.85	13.62	12.15	13.50	13.90	13.18	12.75	13.58	13.88	13.40
V ₂	12.25	13.55	13.70	13.17	11.75	13.30	13.73	12.93	12.00	13.43	13.72	13.04
Mean	12.80	13.60	13.78	13.39	11.95	13.40	13.82	13.06	12.38	13.50	13.80	13.22

N x U

Treatments	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
N ₀	12.25	13.35	12.80	10.55	13.35	11.95	11.40	13.35	12.38
N ₁	13.85	13.35	13.60	13.45	13.35	13.40	13.65	13.35	13.50
N ₂	13.95	13.60	13.78	13.90	13.73	13.82	12.99	13.46	13.22
Mean	13.35	13.60	13.39	12.63	13.48	13.06	12.99	13.46	13.22

Standard Error and Critical Difference

Comparison between means of	S.E.(M) +	C.D. at 5%	S.E. (M) +	U.E. (M) +	S.E.(M) +	C.D. at 5%
V	0.0734	0.2153	0.0866	0.2541	0.0571	0.1625
U	0.0734	-	0.866	0.2541	0.2691	-
N	0.0899	0.2636	0.1061	0.3113	0.2306	-
VU	0.1038	0.3045	0.1225	-	0.0815	0.2292
VN	0.1271	0.3729	0.1501	-	0.1015	0.2891

UN	0.1271	0.3729	0.1501	0.4403	0.2900	-
VUN	0.1798	0.5274	0.2122	-	0.1442	-

Table 4: Mean Yield per Plant of Rhizome (G)

V x U

Treatments							Combined		
	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
V ₁	138.60	151.07	145.28	136.95	149.65	143.30	137.77	150.81	144.29
V ₂	135.67	149.39	142.53	132.92	146.74	139.83	134.29	148.07	141.18
Mean	137.13	150.68	143.90	134.93	148.20	141.56	136.03	149.44	142.74

V x N

Treatment	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean
V ₁	134.65	147.81	153.39	145.28	132.92	145.99	151.01	143.30	133.79	146.89	152.20	144.29
V ₂	131.74	145.30	150.55	142.53	128.38	142.79	148.33	139.83	130.06	144.04	149.44	141.18
Mean	133.20	146.55	151.97	143.91	130.65	144.38	149.67	141.56	131.92	145.46	150.82	142.74

N x U

Treatments	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
N ₀	122.55	143.85	133.20	119.69	141.61	130.65	121.12	142.73	131.91
N ₁	142.80	150.31	146.55	141.10	147.66	144.38	141.95	148.98	145.46
N ₂	146.05	157.89	151.97	144.01	155.33	149.67	145.03	156.61	150.82
Mean	137.13	150.68	143.61	134.93	148.20	141.56	136.03	149.44	142.74

Standard Error and Critical Difference

Comparison between means of	S.E.(M) +	C.D. at 5%	S.E. (M) +	U.E. (M) +	S.E.(M) +	C.D. at 5%
V	0.6512	1.9099	0.9087	2.6653	0.4563	1.2996
U	0.6512	1.9099	0.9087	2.6653	0.4550	1.2960
N	0.7976	2.3393	1.1271	3.2643	0.5512	1.5691
VU	0.9210	-	1.2852	-	0.6438	-
VN	1.1281	-	1.5742	-	0.7819	-
UN	0.1281	3.3089	1.5742	4.6173	0.7814	2.2244
VUN	1.5952	-	2.2261	-	1.1028	-

Table 5: Mean yield of Rhizome Q/HQ.

V x U

Treatments							Combined		
	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
V ₁	267.41	304.63	286.02	265.00	289.63	277.32	266.20	297.13	281.66
V ₂	251.85	275.18	263.52	249.44	272.04	260.74	250.65	273.61	262.13
Mean	259.63	289.91	274.77	257.22	280.83	269.03	258.42	285.37	271.90

V x N

Treatment	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean	N ₀	N ₁	N ₂	Mean
V ₁	254.44	296.39	307.22	286.01	238.44	292.78	304.72	277.32	244.44	294.58	305.97	281.66
V ₂	216.67	278.33	295.56	263.52	213.61	275.28	293.33	260.74	215.14	276.81	294.44	262.13
Mean	235.56	287.36	301.39	274.77	224.03	284.03	299.03	269.03	229.79	265.69	300.21	271.90

N x U

Treatments	U ₀	U ₁	Mean	U ₀	U ₁	Mean	U ₀	U ₁	Mean
N ₀	209.44	261.67	235.56	207.22	240.83	224.03	208.33	251.25	229.79
N ₁	279.72	295.00	287.36	276.94	291.11	284.03	278.33	293.06	265.69
N ₂	289.72	313.06	301.39	287.50	310.56	299.03	288.61	311.81	300.21
Mean	259.63	289.91	274.77	257.22	280.83	269.03	258.42	285.37	271.90

Standard Error and Critical Difference

Comparison between means of	S.E.(M) +	C.D. at 5%	S.E. (M) +	U.E. (M) +	S.E.(M) +	C.D. at 5%
V	2.1167	6.22	2.5167	7.37	1.6333	4.67
U	2.1167	6.22	2.5167	7.37	1.6500	4.67
N	2.6000	7.60	3.0833	9.02	2.0333	5.80
VU	3.0000	8.78	3.5667	-	2.3167	-
VN	3.6667	10.75	4.3667	-	2.8500	8.12

UN	3.6667	10.75	4.3667	-	2.8833	8.22
VUN	5.1833	15.22	6.1667	-	4.0833	-

Result and Discussion

Plant height

It was observed from the analysis of variance Table-1 for the least stage 180 days after sowing that the main effects of variety, Urea and NAA in both the years as well as in Pooled analysis were found to differ significantly, whereas the interaction did not show significant effect.

The two way mean table indicated that variety V₁ (Baruwa Sagar, 57.54 and 58.09 cm.) attained more height than variety V₂ (Rio-de- Janeiro), 56.17 and 56.34 cm.) in both the years and pooled mean (57.81, Baruwa Sagar and 56.25 cm., Rio-de-Janeiro). The data also showed that the application of Urea as foliar spray increased the plant height significantly in both the years as well as in pooled mean.

In respect of doses of NAA, 400 PPM was (N₂) found to be significantly superior over other doses by recording the height of 59.69 and 59.81 cm. in both year respectively. The next dose of 200 PPM (N₁) also recorded maximum height and significantly superior to 0 PPM showing 57.11 and 57.84 cm. as compared to 53.75 and 54.01 cm. in N₀ in both year respectively. Further the pooled analysis also showed the same trend as 59.75, 57.47 and 53.88 cm. in N₂ N₁ and N₀, respectively. The present findings in respect of Urea application are in favour of finding made by Das and Sahoo (1973). We respected that the foliar application of Urea on a crop increased the height of Potato plant. In respect of NAA which showed a pronounced effect in the linear increase in plant height are in conformity with the studies made by Sinha and Upadhy (1967)^[8] on Okra and Das and Padhi 1974 on Potato crops.

The plant height increased significantly in both the varieties due to urea and NAA application. The maximum height was found in variety Baruwa Sagar. In respect of Urea and NAA, the urea 2% and NAA 400 PPM produced maximum height as compared to others in both the years and in pooled mean. The interaction effect were non- significant.

Thickness of Main Stem

It was observed from the analysis of various given by table-2 for the last stage 180 days after planting that the main effects of variety, urea and NAA differed highly significantly in both the years and in pooled analysis.

It was observed from the mean table that variety V₁ (Baruwa Sagar, 0.895, 0.896 and 0.895 cm.) was superior to variety V₂ (Rio-de-Janeiro, 0.881, 0.864 and 0.872 cm.) in respect of thickness in first year second year and in pooled mean. It was also found that the thickness increased significantly with the application of Urea in both the years and pooled analysis. It was further observed that there was maximum thickness in N₂ (NAA 400 PPM, 0.911 cm.) which was at par with N₁ (NAA 200 PPM, 0.901 cm.) and minimum in N₀ (NAA 0 PPM, 0.852 cm.) in the first year however, in the second year all the three levels of NAA and their pooled analysis showed significant differences. The maximum thickness of 0.908 and 0.909 cm. was found in N₂ followed by 0.889 and 0.895 cm. and 0.842 and 0.847 cm. in N₁ and N₀ during second year and pooled mean, respectively.

So far as the interaction of variety and Urea was concerned, the maximum thickness was observed in variety V₁ (Baruwa Sagar with Urea 2 percent as 0.886 Cm. in second year and minimum in variety V₂ (Rio-de-Janeiro) without urea

application as 0.842 and 0.855 cm. in the second year and in pooled analysis, respectively. The response of Urea and its combination with NAA are in good agreement to the finding made by Ozaki and crew 1954, Cunningham 1957, Verma *et. al.* (1970) Das and Padhi (1974).

The thickness of main stem increased significantly, the maximum thickness was observed in variety Baruwa Sagar. The application of urea 2 percent and NAA 400 PPM individually enhanced the thickness of main stem in both the years and pooled mean.

Number of tillers

It was observed from the analysis of variance table-3 for the last stage at 180 days after sowing. The two way mean table indicated that the number of tillers was more in the variety V₁, i.e., Baruwa Sagar as 13.62, 13.18 and 13.40 than variety V₂ i.e., Rio-de-Janeiro recording 13.17, 12.93 and 13.04 number, per plants in the first, second year and in pooled analysis, respectively. The data further showed that treatment N₂ (NAA 400 PPM) produced maximum number of tillers as 13.78 per plant, which was good as to N₁ (NAA 200 PPM) recording 13.40 number of tillers per plant in the first year. However, in the second year N₂ was significantly superior by showing 13.82 number of tillers as compared to 13.40 and 11.75 per plant in N₁ and N₀, respectively.

The interaction between variety and Urea was significant in the first year and pooled analysis both.

It was observed that there was maximum number of tillers (13.70 and 13.58) in V₁ U₀ and V₁ U₁, which was at par with V₁U₁ and V₂ U₁ (13.53 and 13.36) in the first year and pooled mean.

The interaction between Urea and NAA indicate that U₀ N₂ gave maximum number of tillers, 13.95 and 13.90 however, it was at par with U₀ N₁ as 13.85 and 13.45 number of plant in first year and second year, respectively. The minimum number was observed in U₀ N₀ (13.85, 12.63 per plant).

So far as the interaction between variety and NAA was concerned, it was significant in the first year and in pooled mean both. It was further observed that the maximum number of tillers as 13.85 and 13.88 was found in V₁ N₂ which was at par with V₂ N₂, 13.70 and 13.72 per plant in first year and pooled mean, respectively. The data showed the minimum number of tillers in V₂ N₀ as 12.25 and 12.00 per plant in the first year and pooled mean respectively.

The increase in tiller number per plant is in conformity to the finding made by Das and Padhi (1974) who reported that application of Urea 2 per cent with plano fix 250 PPM produced more number of branches on Potato.

The number of tillers was found in variety Baruwa Sagar. The application of NAA 400 PPM and Urea 2 per cent produced maximum number of tillers. In case of interaction V₁ U₀, V₁ U₁ and U₀ N₂ gave maximum number of tillers.

Yield

The average yield per plant under different treatments was recorded in table-4. That the variety V₁ (Baruwa Sagar) was significantly superior to variety V₂ (Rio-de-Janeiro) in both the years and in pooled analysis. The data showed that there was maximum plant yield with application of N₂ (NAA 400 PPM) followed by N₁ (NAA 200 PPM) and minimum in N₀ (NAA 0 PPM) in both the years as well as in pooled mean.

The maximum value was 151.97 gm. in the first year in N₂, 149.67 g in the second year and 150.82 gm. per plant in the pooled mean. Similarly, the application of urea 2 per cent also produced the higher yield to the tune of 150.68, 148.20 and 149.44 gm. per plant respectively in the first year second year and in pooled mean.

The mean yield of Rhizome under different treatments have been presented in table-5. That variety V₁ (Baruwa Sagar) was significantly superior to variety V₂ (Rio-de-Janerio) in both the years as well as in pooled mean. The yield values were 286.02, 277.32, 281.66 qu/hac. in first year second year and pooled mean respectively. The application of urea also showed significant increased in yield in both the years as well as in pooled mean. Similarly, the N₂ (NAA 400 PPM) gave the maximum followed by N₁ (NAA 200 PPM) and N₀ (NAA 0 PPM) to the tune of 301.39, 299.03 and 300.21, 287.36, 284.03 and 235.56, 244.03 and 258.42 q/ha in first year, second year and pooled mean, respectively.

In case of interaction of variety with urea (V x U), the highest yield of 304.63 q/ha. was found in V₁ U₁ (Baruwa Sagar with Urea 2%) followed by 275.18 on V₂ U₁ (Rio-de-Janerio with urea 2%), 267.41 in V₁ U₀ and 251.85 q/ha in V₂ U₀ treatment combination.

The effect of urea spray for the improvement of yield in Potato have been reported by Mehrotra *et al.* (1969) and Das and Sahoo (1973). The improvement of yield by applying urea 2 per cent spray has been reported by Shanmugam and Thamburaj (1974) in the case of Potato and topioca).

The yield per plant showed the main effect of variety, urea and NAA and the interaction effect of Urea and NAA in both the years as well as in pooled mean. The variety Baruwa Sagar was significantly superior. The maximum rhizome yield per plant was found in NAA 400 PPM and Urea 2 per cent and there combination.

In case of yield per hectare showed the variety Baruwa Sagar was significantly superior to Rio-de-Janeiro. The urea 2 per cent and NAA 400 PPM gave higher yield. However, best response was found in case of urea 2 per cent with NAA 400 PPM application (U₁ N₂).

References

1. Harms Charles L, Oplinger Edward S. Plant Growth Regulators, Their use in crop production. North Central Fteigion Extension publication 2014,303.
2. Baligar VC, Fageria NK, HeZL. Nutrient use efficiency in Plants. Communication in soil science and plant analysis 2001;32:921-950.
3. Singh M, Masroor M, Khan A, Naeem M. Effect of nitrogen on growth, Nutrient assimilation, essential oil content, yield and quality attributes in Zingiber officinale Roscoe. Journal of the Saudi Society of Agricultural Sciences 2014;15:171-178.
4. Medda PS, Hore JK. Effects of N and K on the growth and yield of turmeric in alluvial plains of West Bengal. Indian J of Hort 2003;60:84-88. Link.
5. Kar Jadi AK, Buchori A. The effect of NAA and BAP on meristem growth of garlic in B5 medium. J. Horticulture 2007;17:217-223.
6. Devasenapathy P, Jagannathan NT, Subbiah K. Effect of NAA on ground nut. India J. Agron 1987;32:176-177.
7. Varma AN, Srivastava DC, Sharm RK. Effect of urea spray on growth, yield and quality of tomato. Mysore J. Agri. Science Sci 1970;4:107-09.
8. Sinha, K, Upadhyay SK. Effect of Soil and foliar

application of NAA of vegetative growth and yield of Okra (*Abelmoschus esculentus* (L.) Moench). Ind. J. Agri 1967;12:42-45.

9. Das RC, Nair GS. Study on the effect of foliar application of urea and Planofix on the growth yield and quality of ginger varieties. Thesis submitted to the OUAT, Bhubaneshwar 1975.
10. Chaturvedi I. Effect of nitrogen fertilizer on growth, yield and quality of hybrid rice (*oryza Sativa* L.) Journal of central European Agriculture 2006;6:611-618.