

Original Research Article

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Effect of Nitrogen Level and Plant Growth Regulators in Maize (*Zea mays* L.)

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ABSTRACT

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The experiment was carried out during *Rabi* season of 2019-2020 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The experiment was carried out in RBD having 12 treatment which replicate thrice. From the present experiment the treatment 10 (120 kg Nitrogen + NAA 40 ppm) have Higher plant height (181.66 cm), Maximum No. of cob/plant (2.30), Maximum 100 seed weight(31.50 g), Maximum Grain yield (5015.33 kg/ha), Maximum Maximum Gross return (Rs. 96930.40/ha) and Maximum B:C ratio (2.17), the highest harvest index (36.27%) was observed in treatment 3 (80 kg/ha Nitrogen + Mepiquat Chloride 200 ppm).

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop next to rice and wheat and has the highest production potential among the cereals. Maize is the most important cereal crop of the world after wheat and rice, growing everywhere in the irrigated as well as in rain-fed areas. It is staple food of rural population in India. As a grain crop, maize is a rich source of food and it is also used on large scale in industries for

manufacturing of corn oil, corn flakes and corn sugar. Attention is now being paid to explore its potential in India, for earning foreign exchange besides higher economic returns to the farmers. Thus, it is essential to standardize the agro techniques for maize growing in order to popularize its cultivation among farming community.

Timing of nitrogen application based on the requirement is important to increase the nitrogen use efficiency. Growth regulators

can improve the effective partitioning and translocation of assimilates from source to sink in the field crops. Being a new plant type, the response on different plant growth regulators and split application of nitrogen under irrigated conditions was thought to be experimented.

Nitrogen fertilization plays significant role in improving soil fertility and increasing crop productivity. Nitrogen fertilizer results in increased grain yield (43-68%) and biomass (25- 42%) in maize. Chemical fertilizer application could not be avoided completely since they are the potential sources of high amount of nutrients in easily available forms and maize is more responsive to it.

An increase in yield of maize with increasing rate of nitrogen has been reported by many researchers primarily due to its favorable effect on yield components of maize.

PGRs are certain chemical substances, when applied in small quantities, can rapidly change the physiology and phenotype of the plant. They enhance or stimulate the natural growth regulatory system prompting growth of the plant from germination of seed till the senescence. PGRs improve the source sink relationship and help in stimulating the translocation of photosynthates there by aid in formation of flowers and development of fruit seed resulting in enhanced crop productivity. Among various PGRs Mepiquat Chloride (MC) is a water soluble plant growth regulator and when sprayed on the plant it acts systematically after its absorption by plant leaves. It acts as a gibberellic acid inhibitor and inhibits cell elongation there by reducing the longitudinal growth of the plant. It has also shown to be useful in determinate crops. The chemical namely diamineputrescine occurs extensively in higher plants and is believed to have involvement in various growth and

developmental processes such as cell division fruit set and growth and senescence. The interaction between polyamines and macromolecules is believed to be reason for physiologically affecting the growth and development of the plant. NAA (auxin) promotes vegetative growth by enhancing cell division, enlargement and elongation, thus helping in improvement of growth characteristics and reproductive growth stimulation.

PGRs either promoters or retardants can be used to change the morphology of plant by affecting the stem length and leaf size. Growth retardants on one side can reduce the canopy of the plant there by allowing higher and rapid translocation of photosynthates towards sink i.e. green young cob and on other side, growth promoters can enhance the overall growth of plant resulting in more leaf area and thus more photosynthesis. PGRs can also lead to better physiological efficiency of plant such as photosynthetic ability and can improve effective partitioning of the photosynthetic assimilates from source and sink. Application of PGRs in the form of foliar spray at pre flowering stage helps in improving physiological efficiency along with crop productivity.

Material and Methods

The experiment was carried out during *Rabi* season of 2019-2020 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. the soil of the experimental field was sandy loam in texture having pH 7.4, medium in available NPK but low in organic carbon *i.e.* 0.03%. The experiment was conducted in Randomized Block Design consisting of 12 treatments combinations with 3 replications and was allocated randomly in

each replication The experimental crop were raised by using K-27 which is High yielding variety and recommended for U. P. The crop was sown on 16 November 2019.

Statistical analysis

The experiment data was collected to analyse statistical by Fishers method of Analysis (ANOVA) as outline by Gomen and Gomez (2010). Critical Difference (CD) value were calculated whenever the F test value was found significant at 5% level.

Results and Discussion

At the time of harvesting the significant and maximum plant height (181.66 cm) was observed in treatment 10 (120 kg Nitrogen + NAA 40 ppm) However treatment 6 [100 kg/ha Nitrogen + NAA 40 ppm] and 12 (120 kg Nitrogen + Putrescine 50 ppm) was found to be at par with treatment 10(120 kg Nitrogen + NAA 40 ppm)

The increase in plant height might be due to the plant growth regulators have significant impact on the growth regulation of the various crops especially maize Plant growth was maximum in NAA treated group, the pattern of growth rate remained same at harvest stage of the crop when it reached to 181.66 cm in NAA followed by putrescine group *i.e.* 177.66 cm. Plant growth observation confirmed their consistent effect on the crop till harvest. Nargis and Nilufar, (2017) have also reported increased plant height while using NAA in maize crop.

The maximum Number of cob/plant (2.3 cob/plant) was found in treatment 10 (120 kg Nitrogen + NAA 40 ppm)and followed by 2.20 cob/plant in treatment 6 (100 kg/ha Nitrogen + NAA 40 ppm), 9 (120 kg/ha Nitrogen) and 12 (120 kg Nitrogen + Putrescine 50 ppm).

Application of nitrogen in three split doses must have helped in continuous supply of nitrogen to plants to maintain greenness of leaves for longer period which in turn helped in higher grain yield which might have contributed much to the developing sink and thereby increased the seed weight of maize (Misra *et al.*, 1994). Application of nitrogen in three split doses is conducive for regulating the supply of fertilizer nitrogen over the whole of the active growth phase of plant. Increase in yield under nitrogen may also be due to the fact that when a considerable amount of nitrogen is applied at or near to anthesis, there is a greater possibility of its accumulation in sink rather than in other vegetative parts, in PGR group, the weight of the grains varied from 26.7-30.2 g with significant increase in NAA and Putrescine group whereas it was similar in Mepiquat Chloride and control. Present findings are in agreement with Rahman *et al.*, (2016), they have also reported 100 grains weight at 25.27 g, similar findings are reported by Gul *et al.*, (2015).

The significant variation in 100 seed weight was observed and the maximum 100 seed weight (31.5 g) was found in treatment 10 (120 kg Nitrogen + NAA 40 ppm) however treatment 12(120 kg Nitrogen + Putrescine 50 ppm) was found to be at par with treatment 10.

The significant and maximum Grain yield (5015.33 Kg/ha) was recorded in treatment 10 (120 kg Nitrogen + NAA 40 ppm) However treatment 6 (100 kg/ha Nitrogen + NAA 40 ppm) and 12 (120 kg Nitrogen + Putrescine 50 ppm) was found to be at par with treatment 10 (120 kg Nitrogen + NAA 40 ppm)

This improvement in grain yield might be due to an early and plentiful availability of nitrogen leading to better nutritional environment in the root zone for growth and development.

Table.1 Effect on yield attribute of maize

Treatment Details	Plant height At Harvesting	Number of cobs/plant	100 grain weight (g)	Grain yield (kg/ha)	Harvest index (%)	Gross return (Rs./ha)	B:C
1. 80 kg/ha Nitrogen	139.00	2.13	26.36	3,563.33	36.18	68643.96	1.58
2. 80 kg/ha Nitrogen + NAA 40 ppm	166.00	1.93	28.86	4,226.66	35.46	81658.64	1.85
3. 80 kg/ha Nitrogen + Mepiquat Chloride 200 ppm	132.00	2.13	26.16	3,138.66	36.27	60437.62	1.35
4. 80 kg/ha Nitrogen + Putrescine 50 ppm	162.33	2.00	28.86	4,173.33	35.50	80614.29	1.79
5. 100 kg/ha Nitrogen	155.00	2.13	27.30	3,933.66	36.23	75761.83	1.73
6. 100 kg/ha Nitrogen + NAA 40 ppm	175.00	2.20	30.43	4,778.00	35.46	92311.71	2.08
7. 100 kg/ha Nitrogen + Mepiquat Chloride 200 ppm	142.33	1.93	26.83	3,699.66	36.23	71254.47	1.58
8. 100 kg/ha Nitrogen + Putrescine 50 ppm	171.66	2.06	30.10	4,712.33	35.46	91043.43	2.01
9. 120 kg/ha Nitrogen	162.00	2.20	27.73	4,122.00	36.10	79430.50	1.80
10. 120 kg Nitrogen + NAA 40 ppm	181.66	2.30	31.50	5,015.33	35.37	96930.40	2.17
11. 120 kg Nitrogen + Mepiquat Chloride 200 ppm	147.33	2.06	27.23	3,921.00	36.18	75530.90	1.67
12. 120 kg Nitrogen + Putrescine 50 ppm	177.66	2.20	30.80	4,962.00	35.50	95849.91	2.10
F-test	S	NS	S	S	S	-	-
Se(m)±	3.30	0.083	0.25	94.53	0.08	-	-
CD(p=0.05)	9.74	-	0.74	279.03	0.24	-	-

As nitrogen is one of the major essential plant nutrients required for growth. Therefore, increased availability of nitrogen might have increased cell number and cell size leading to better growth in terms of plant growth. Nitrogen is an element of chlorophyll, it harnesses solar energy and fixes atmospheric CO₂ as carbohydrates and amino acids. Thus nitrogen application increased dry matter production. The increase supply of nitrogen and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and leads to increased growth parameters, yield attributes and yield. The enhanced growth with nitrogen has also been reported by Bindhani *et al.*, (2007), Sahoo and Mahapatra (2007), Gul *et al.*, (2015) and Rahman *et al.*, (2016). Foliar application of PGRs directly influences the plant vegetative growth that in turn results into higher yield in maize crop.

The Significant and maximum Harvest index 36.27 % was found in treatment 3 (80 kg/ha Nitrogen + Mepiquat Chloride 200 ppm) However treatment 1 (80 kg/ha Nitrogen), 5 (100 kg/ha Nitrogen), 7 (100 kg/ha Nitrogen + Mepiquat Chloride 200 ppm), 9 (120 kg/ha Nitrogen) and 11 (120 kg Nitrogen + Mepiquat Chloride 200 ppm) was found to be at par with treatment 3 (80 kg/ha Nitrogen + Mepiquat Chloride 200 ppm)

The higher Harvest index was due to the supraoptimal temperature during anthesis which reduce seed set which leads to sink limitation and increases harvest index. High temperature during crop season might have affected translocation efficiency which resulted into poor crop yield. The weak source-sink relationship due to high temperature was also reported by Suwa *et al.*, (2010). This finding was in close agreement with those of Shrestha *et al.*, (2016)

The maximum gross return Rs. 96930.40/ha was reported in treatment 10 (120 kg Nitrogen

+ NAA 40 ppm) which is followed by Treatment 12 (120 kg Nitrogen + Putrescine 50 ppm)*i.e.* Rs. 95849.91/ha

The maximum B:C ratio (2.17) was recorded in treatment 10 (120 kg Nitrogen + NAA 40 ppm) and followed by treatment 12 (120 kg Nitrogen + Putrescine 50 ppm)

From the above experiment it is concluded that treatment 10 (120 kg Nitrogen + NAA 40 ppm) have Higher plant height, Maximum No. of cob/plant, Maximum 100 seed weight, Maximum Grain yield (kg/ha), Maximum Harvest Index (%), Maximum Gross return and Maximum B:C ratio.

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