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Effect of Different Concentration of Gibberellic Acid and Auxin on Germination of Onion Seed

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ABSTRACT

Onion (Allium cepa L.) is the oldest bulbous vegetable crop having high nutritive as well as market value. Short viability and low quality of onion seeds are the reasons for slow and asynchronous germination. Therefore, the study was carried out to find the appropriate growth regulator and its concentration that enhances the germination of Red Creole variety of onion seed. The experiment was conducted in Agronomy lab of IAAS, Lamjung Campus during the period from December 30, 2016, to January 12, 2017. The design of experiment was Complete Randomized Block Design (CRD) with nine Treatments 10ppm, 50ppm, 100ppm and 150ppm of auxin and 10ppm, 50ppm, 100ppm and 150ppm of gibberellic acid and control. Seeds treated with the same volume of respective concentration and kept in germination at temperature 20±2°C. Onion seeds were evaluated for germination percentage, vigor index, root length, shoot length, seedling length, fresh weight, and dry weight. Three replication of each treatment with 50 seeds per replication were arranged in Petri-plate containing blotting paper. From the experiment, highest germination perocentage (69%) was at 100ppm of GA3, which was significantly different from GA3 at 50ppm (65%), GA3 at 10ppm (64.67%) and auxin at 50ppm (55%). Auxin at higher concentration viz. 50ppm, 100ppm, and 150ppm inhibited the germination. Comparative study of auxin and GA3 at the different concentration on root length, shoot length, seedling length, fresh weight, and dry weight revealed that GA3 and auxin were highly effective. Thus, GA3 at 100ppm promotes the viability and quality of onion seeds, which enhances its germination.

Keywords: Auxin, Germination, Gibberellic acid, Onion.

INTRODUCTION

Onion (*Allium cepa*) is one of the oldest bulbous vegetable crop having highly nutritive value. The external application of plant growth regulators affects the endogenous hormone pattern of the plant, either by supplementation of sub-optimal levels or by interaction with their synthesis, translocation or inactivation of existing hormone levels (Muhammad et al., 1993). Pre-sowing treatment affects Osmo-conditioning and this method improves seed performance and provides faster and synchronized germination (Siveritepa and Dourado, 1995). Among all the plant growth regulators, auxin and gibberellin have a vital role in regulating developmental processes within plant bodies (Ouzounidou et al., 2011).

Gibberellic Acid-3 (GA) is a naturally occurring plant growth regulator, which causes a variety of effects including the stimulation of seed germination. In many cases, presoaking seeds in GA solution causes rapid germination of many types of highly dormant seeds. Effects are highly dependent on concentration and the stage of plant growth (Hudson, 2017). GA3 stimulates germination by inducing hydrolytic enzymes that weaken the barrier tissues like endosperm or seed coat, inducing mobilization of seed storage reservoirs and stimulation for expansion of the embryo (Bewley and Black, 1994). Naphthalene Acetic Acid (NAA) is purely synthetic auxin, which is similar to IAA in structure but more effective in promoting rooting. It has a vital role in improving seed peroxidase and catalase activities including the integrity of the cell membrane, seed germination rate and promotes

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the different rooting plants to germinate (Zhang et al., 2006). For the rapid and uniform seedling emergence, the high quality seed is necessary but unfortunately, onion seeds have low quality, resulting in slow and asynchronous germination. This experiment was conducted to examine the effect of auxin and GA that might affect germination of onion seeds

MATERIALS AND METHODS

The laboratory experiment was conducted during the period from December 30, 2016, to January 12, 2017, in Agronomy lab of IAAS Lamjung Campus, Sundarbazar, Lamjung district. For the study of seed germination, healthy Red creole variety of onion seeds were collected from nearby agro-vet. The design of experiment was Complete Randomized Block Design (CRD) with nine Treatments 10ppm, 50ppm, 100ppm and 150ppm of auxin and 10ppm, 50ppm, 100ppm and 150ppm of gibberellic acid. Along with the other treatments, ninth treatment was control in which distilled water was poured. Three replication of each treatment with 50 seeds per replication were arranged in Petri-plate containing blotting paper and moistened with 5ml of each treatment solutions and kept in germinator at temperature 20±2°C. For germination test, seeds were considered to germinate up to radicle emergence. The first germination was seen on the third day. Numbers of germinated seeds were recorded from the emergence day. On the second day, no moisture was added but from the third day, 2ml of the solution was added for the rest of days and germinated seeds number was also recorded at the same time. Final germination percentage was calculated on the thirteenth day. Average root length, shoot length, seedling length, fresh weight, dry weight, and vigor index were calculated on the thirteenth day. For calculating fresh weight, 15 seedlings from each treatment were collected. For dry weight, it was oven dried for two days at 105°C. Data entry and tabulation was accomplished by using MS-excel. Microsoft word 2016 was used for word processing. The analysis was done by using SPSS 16.0. All the data were subjected to Tukey and LSD for mean comparison. The test was done at 1% level of significance and 5% level of significance for ANOVA.

RESULT AND DISCUSSION

Table no: 1. Effect of different concentration of auxin and GA on germination percentage, vigor index, root length, shoot length, seedling length, fresh weight, and dry weight in Lamjung Campus, 2016.

Treatment	Germination %	Vigor index	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Fresh weight (g)	Dry weight (g)
GA 10 ppm	64.67^{c}	249.40^{c}	0.74^{c}	2.88^{bc}	3.83^{bc}	0.483^{cd}	0.040^{b}
.GA 50 ppm	65^{bc}	288.14^{bc}	1.96^{b}	3.03^{b}	4.26^{bc}	0.523^{bc}	0.023^{bc}
GA 100 ppm	69^{a}	411.47^{a}	2.97^{a}	3.73^{a}	6.11^{a}	0.550^{ab}	0.070^{a}
GA 150 ppm	67.33^{abc}	298.55^{b}	1.64^{b}	3.55^{a}	4.49^{b}	0.600^{a}	0.033^{bc}
Auxin 10 ppm	68.33^{ab}	196.40^{d}	0.1^{d}	2.52^{cd}	2.67^{de}	0.493^{bcd}	0.020^{bc}
Auxin 50 ppm	55^{de}	123.18^{e}	0.22^{d}	2.05^{de}	2.22^{ef}	0.450^{de}	0.023^{bc}
Auxin 100 ppm	52.33^{ef}	88.88^{ef}	0.22^{d}	1.79^{d}	1.36^{fg}	0.417^{ef}	0.020^{bc}

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Auxin 150 ppm	51.33^{f}	56.07^{f}	0.15^{d}	0.91^{e}	1.01^{g}	0.367^{f}	0.017^{c}
Control	57^{d}	180.79^{d}	0.52^{cd}	2.81^{bc}	3.39^{cd}	0.480^{cde}	0.013^{c}
Significance	**	**	**	**	**	**	**

**= Significant at 0.01 level of significance *= Significant at 0.05 level of significance

Means in a column followed by the same letter (s) are not significantly different.

Germination percentage

Effect of treatment on germination percentage of onion was highly significant. GA3 at 100ppm had the highest germination percentage (69%), which was statistically at par with GA3 at 150ppm (68.33%) and 10ppm (67.33%) of auxin. The auxin treatment at 150ppm had the lowest germination percentage (51.33%). The auxin at 50ppm, 100ppm and 150ppm had lower germination percentage as compared to control (57%). It may be because GA3 increases the amino acid content in the embryo and causes the release of a hydrolytic enzyme, which is required for digestion of endospermic starch resulting in increased seed germination percentage. Auxin (IAA) treated black gram and horse gram seeds showed maximum germination at 10ppm (Chauhan et al., 2009) which was similar to this result.

Vigor index

Highest vigor index was 411.47 with the treatment of 100ppm GA3 and treatment that received auxin at 150ppm had the lowest vigor index, which was very low in comparison with control (180.79). NAA treatment also enhances the vigor index compared to control which is similar to the report of Abdelgadir et al. (2011).

Root length

Root length variation was highly significant among the different concentration of auxin and GA3. Longest root length was at 100ppm (2.97cm) of GA3 and shortest was at 150ppm (.15cm) of auxin. Sugar beet seed treated with 100ppm of GA3 showed maximum root length (Muhammad and Rha, 2007) which agrees with this result.

Shoot length

Effect of treatments on shoot length of onion was highly significant. The treatment with 100ppm (3.73cm) of GA3 showed more enhancement in shoot length. Auxin at 150ppm (.91cm) had shortest shoot length in comparison with control. This result is in agreement with Mohammad and Mohammad, (2002) which said 100ppm of GA3 stimulated shoot elongation more efficiently than other treatment.

Seedling length

Variation in seedling length was highly significant among different concentrations. The longest seedling length was at 100ppm (6.11cm) of GA3 followed by GA3 at 150ppm (4.49cm) which was statistically at par with GA3 at 50ppm (4.26cm) and 10ppm (3.88cm), whereas shortest at 150ppm(1.01cm) of auxin. This result may be because of the fact that an increase in auxin concentration inhibits the plant growth. High concentration of auxin of all types stimulates many kinds of plant cells to produce ethylene, which retards elongation of both shoot and root (Salisbury and Ross, 1992).

Fresh weight

Fresh weight was highly significant with the treatments of auxin and GA3. Maximum weight was at 150ppm (0.600g) of GA3. Minimum weight was at 150ppm (0.367g) of auxin compared to control (0.480g).

Dry weight

Effect of treatments on dry weight was highly significant. Maximum dry weight was at 100ppm (0.070g) of GA3 followed by GA3 at 10ppm (0.040g). The minimum dry weight was in control (0.013g). GA3 treatment helps to

stimulate the dry matter accumulation, which was also similar with reports of Lokhande et al. (2014), Hore et al. (1988) and Iqbal et al. (2001) in different plants.

CONCLUSION

The obtained results indicated onion seeds treatment with GA3 and auxin, especially GA3 at 100ppm is likely to be more effective to enhance the germination. However, it appears that higher concentrations (50ppm, 100ppm, and 150ppm) of auxin inhibits germination. Other growth parameters like vigor index, seedling length, root length, shoot length, fresh weight, and dry weight were also highly effective by PGRs treatment. Therefore, onion seed germination and seedling growth parameters can be improved by application GA3 and auxin at a lower concentration.

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