Effect Of Growth Hormones On Seed Germination And Seedling Growth Of Black Gram And Horse Gram

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Abstract: The experiment was undertaken with an objective to determine how the rate of seed germination and seedling growth can be influenced by various concentrations of growth regulators i.e. GA_3 and IAA in Black gram and Horse gram. The seed material was collected from the agricultural fields of Maletha, a nearby village of Srinagar town, Uttarakhand (India). Seed moisture content was determined and found optimum for seed testing. The seeds were soaked in different concentrations (10, 50, and 100 ppm) of GA_3 and IAA for 24 hours. Four replicates of each treatment with 20 seeds per replicate were arranged for precise analysis. Significant variation was found between the Black gram and Horse gram in all aspects. T_2 (GA_3 10 ppm) showed highest germination percentage as well as the higher radicle and plumule length in contrast to other treatments. But when considered particularly on the radicle and plumule elongation, these did not show any significant effect on both the crop species. [The Journal of American Science. 2009;5(5):79-84]. (ISSN 1545-1003).

Key words: GA_3, IAA, germination, radicle, plumule, treatment.

Introduction

Black gram (*Vigna mungo*) and Horse gram (*Macrotyloma uniflorum)* is an important short duration pulse crop grown in many parts of India, cultivating both in Kharif and Rabi season. The optimum temperature for better growth of these crops ranges between 25 to 35^{0}C, but it can tolerate up to 42^{0}C which permit to cultivate during summer and winter season. The Horse gram is mainly cultivated in hilly areas and commonly grown up at 1800 msl but the Black gram is cultivated both in hilly and plain regions.

The evidence for hormone involvement comes from correlation of hormone concentration with specific development stages, effects of applied hormones and the relationship of hormones to metabolic activities. Sometimes response on growth or differentiation is inhibited by hormones, especially Abscisic acid. This inhibition is removed by the use of certain growth regulators like Gibberellin and Auxins. The applications of gibberellins increases the seed germination percentage by attributing the fact that they increase the amino acid content in embryo and cause release of hydrolytic enzyme required for digestion of endospermic starch when seeds renew growth at germination. GA acts synergistically with auxins, cytokinins and probably with the other hormone, is what might be called a system approach, or synergism. The overall development of plant is regulated by the growth hormones, nutrient and environmental factors. They also vary in their germination requirement. It is not known that in which concentrations these hormones will cause a response in the cell. This investigation with growth hormones will help in determining that which of hormonal concentration are suitable for seed germination and seedling growth. This analysis is considered necessary since the beneficial effect of presoaking treatment of seeds with growth regulator and other substances have been reported in the literature repeatedly.

Gibberellic acid (GA_3) is known to be concerned in the regulation of plant responses to the external environment (Chakrabarti and Mukherji, 2003), also, application of another plant growth bio-regulator has increased the saline tolerance of many crop plants (Haroun et al., 1991; Hoque and Haque, 2002). GA_3 has also been shown to alleviate the effects of salt stress on water use efficiency (Aldesuquy and Ibrahim, 2001). Das Gupta *et al*.

(1994) recorded that foliar application of plant growth regulators like IAA and GA helped the plant to restore retardation in water content in Mungbean plants subjected to water stress. Chakrabarti and Mukherji (2002) noticed that GA_3 used to overcome the adverse effects in Mungbean plants. The role of plant growth regulators in overcoming the harmful effects of salinity on growth may be due to the change in the endogenous growth regulators which affects plant water balance. In view of the above back ground the present investigation was undertaken to study the influence of growth substances by different concentration on seed germination, radicle and plumule elongation to draw the information of timing and control of seed germination and seedling growth of species in nature.

Materials and Methods

The investigation was conducted at the Seed Testing Laboratory, Department of Seed Science & Technology, H. N. B. Garhwal Central University, with an objective to determine the rate of seed germination and seedling growth which influenced by various concentrations of growth regulators in Black gram (*Vigna mungo*) and Horse gram (*Macrotyloma uniflorum).* Seeds were collected from Maletha, a small village situated near Srinagar town in Uttarakhand (India) in the month of January 2007 which were stored at room temperature till used for the experimentation.

Moisture content of seed was determined by using oven at 103^0C for 12 hrs. The moisture percent was found within the recommended value 9.8 and 10.3 for Horse gram and Black gram respectively. The seeds were treated under different concentrations of 10, 50 and 100 ppm of GA_3 and IAA with a separate control set (Table 1). These were soaked for 24 hours in the above concentrations and only double distilled water for the control set.

Table 1. The treatments of GA_3 and IAA with different concentrations

Treatments	Concentration (ppm)	Growth hormone	Seed soaked time (hrs)
T_1 (control)	---	---	24
T_2	10	GA_3	24
T_3	50	GA_3	24
T_4	100	GA_3	24
T_5	10	IAA	24
T_6	50	IAA	24
T_7	100	IAA	24

Four replicates of each treatment with 20 seeds to each replicate were placed in seed germinator, 20^0C. Observation aspects like germination count (recorded for nine days), measurement of radicle and plumule length was measured (recorded for 15 days). Seed germination was recorded by skipping every two days and radicle and plumule length was measured every alternate day till the final day of experimentation. The mean germination percent, radicle and plumule length of each treatment were calculated, and for quantitative evaluation of effect of various treatments, the values were used to compare with the control treatment observation values. The experiment was laid out in a Randomized Block Design (RBD) with 7 treatments. Data collected were analysed statistically using coefficients of variability and least significant difference (LSD) test at 0.05 probability level (Steel and Torrie, 1984).

Results and Discussion

Low germination percentage was observed in control treatment of both the crop (Table 2). The seeds treated with GA_3 showed significant difference to control. The germination percent of treatment GA_3 10 ppm, was recorded a difference of nearly 4 to 10% to treatment 50 and 100 ppm, in which GA_3 10 ppm was found most suitable because it showed highest germination percent. Both 50 and 100 ppm concentration of GA_3 did not show any major difference in respect of germination which meant the higher concentration was not as good as the lower concentration rather it decreased the germination percent. Germination percentage under the treatment of IAA at 10 ppm recorded maximum in both the crop. A significant difference was observed between 10 ppm and the other two treatments. The highest concentration of IAA (100 ppm) showed the least germination percentage (38.75%) in Black gram and (46.25%) in Horse gram. Hence from above it is observed that in both the cases whether it is GA_3 or

IAA, the germination percentage decreases when the concentration increased, which shows that higher concentration inhibit germination. Observations revealed both the growth hormones response uniformly to radicle elongation (Table 4). The length of radicle for control treatment on the terminating day of experiment was observed to be 5.3 and 6.1 cm in Black gram and Horse gram respectively. The longest radicle length was observed under T_3, GA_3 50 ppm (5.97 cm) in Black gram, but same observation of 6.1 cm in both treatments T_1 (control) and T_2 (GA_3 10 ppm) was recorded in Horsegram. A uniform plumule elongation was observed in the treatments of GA_3 to both the crop species indicating growth hormone GA_3 had good response. But IAA treatments in both the crop species showed great variation among the treatments and moderate difference to GA_3 treatments. When we compared the control treatment to the other treatments particularly to the maximum length, observation showed not any significant difference which meant there was not great effect by the treatment of growth hormones.

Substantial variation on germination and other aspects was found between both the crop species (Table 5). All the treatments were recorded more effective in Horse gram. In the IAA treatments, plumule elongation was found in decreasing trend with the increase of hormonal concentration. It was observed that for germination enhancement of Black gram and Horse gram, GA_3 with lower concentration was best suited, but in case of radicle and plumule elongation, both these hormones did not show any significant effect. When the two hormones were compared, Gibberellic acid (GA_3) was observed more effective and responsive to the regulation of radicle and plumule elongation which support the report of Chakrabarti and Mukherji (2003). The application of another plant growth regulator could increased the seed germination and other physiological activity by the reason of tolerance to the toxic particles which was found in consistent with the finding of Haroun et al. (1991); Hoque and Haque (2002). With the more effectiveness of low concentration of GA_3 (that is ratio of growth hormone and water) (Table 3) could restore retardation in water content, this may able to tolerance to water stress. The result was considered in parallel to the findings of Das Gupta *et al*. (1994). As from the Table 2 information have shown that GA_3 could overcome the adverse effects in Black gram and Horse gram than the IAA in the seed physiological activity, the findings supports the report of Chakrabarti and Mukherji (2002). The role of plant growth regulators in overcoming the harmful effects on growth may be due to the change in the endogenous growth regulators (Izumi and Eiji 1996). Although varied in seed germination and root shoot elongation by different treatments, the pre-soaking with different treatments evident that soaked seed could improve in germination and seedling establishment and this observation was found equivalent the observation of Ahmad *et al*., (1998); Harris *et al*., (1999). The soaking period of 24 hrs increased the total uptake of water which help the maximum imbibition rate. This in turn aid to the quick biochemical changes and time period was found suitable for seed germination. Same experiment was conducted in Black gram and Horse gram by Mohanty and Sahoo (2006).

Table 2. Range and mean of Black gram and Horse gram seed germination of different treatments. The maximum mean value indicated the maximum seed germination percent.
*showing the maximum germination percent in T_2. T_7 (IAA 100 ppm) was found most unsuitable for seed germination treatment

Treatments	Black gram		Horse gram	
	Range	Mean	Range	Mean
T1 (control)	53.00 – 62.00	57.50	45.00 – 56.75	50.87
T2	83.75 – 98.00	90.87*	96.25 – 99.00	97.62*
T3	81.25 – 88.75	85.00	82.50 – 96.25	89.37
T4	65.00 – 87.50	76.25	95.75 – 98.75	97.25
T5	58.75 – 80.00	69.37	87.5 – 95.75	91.62
T6	26.25 – 68.75	47.50	7.50 – 50.00	28.75
T7	10.00 – 38.75	24.37	2.50 – 46.25	24.37

Table 3. Mean seed germination percent of first count and final count. The maximum first count value indicated the quick and more effective treatment. Note the range differences in the IAA treatments.
*maximum first count value and **maximum final count value in treatment T_2 (GA_3 10 ppm) to both the crop species

Treatments	Blackgram			Horse gram		
	First count	Final count	Range difference	First count	Final count	Range difference
T1 (control)	53.00	62.00	9.00	45.00	56.75	11.75
T2	83.75*	98.00**	14.25	96.25*	99.00**	2.75
T3	81.25	88.75	7.50	82.50	96.25	13.75
T4	65.00	87.50	22.50	95.75	98.75	3.00
T5	58.75	80.00	21.25	87.50	95.75	8.25
T6	26.25	68.75	42.50	7.50	50.00	42.50
T7	10.00	38.75	28.75	2.50	46.25	43.75

Table 4. Range and mean of Black gram and Horse gram radicle and plumule elongation under different treatments. *Represented the maximum mean of range i.e., longest radicle or plumule. #Contrast in the length of final lengths and range mean value. The contrast was due to the non-spontaneous effect of treatment

Treatments	Black gram						Horse gram					
	Radicle			Plumule			Radicle			Plumule		
	Range	Mean	Range difference	Range	Mean	Range difference	Range	Mean	Range difference	Range	Mean	Range difference
T1 (control)	2.45 - 5.30	3.87	2.85	3.25 - 7.51	5.38	4.26	4.30 - 6.10	5.20#	1.80	4.53 - 8.20	6.36	3.67
T2	2.75 - 4.88	3.81	2.13	4.65 - 7.92	6.28#	3.27	3.60 - 6.10	4.85#	2.50	6.40 - 9.50	7.95	3.10
T3	3.05 - 5.97	4.51*	2.92*	4.13 - 7.22	5.67	3.09	4.78 - 5.30	5.04	0.52	6.20 -10.50	8.35*	4.30
T4	2.30 - 5.45	3.87	3.15	5.13 - 7.66	6.39#	2.53	3.80 - 5.50	4.65	1.70	6.73 - 9.20	7.96	2.47
T5	2.20 - 5.60	3.90	3.40	4.65 - 6.62	5.63	1.97	4.33 - 5.90	5.11	1.57	4.95 - 8.50	6.72	3.55
T6	2.23 - 4.10	3.16	1.87	2.03 - 4.78	3.40	2.75	1.40 - 3.00	2.20	1.60	1.13 - 6.80	3.96	5.67
T7	0.85 - 3.38	2.11	2.53	0.80 - 4.33	2.56	3.53	0.50 - 5.00	2.75	4.50	0.57 - 5.90	3.23	5.33

Table 5. Germination percent, radicle and plumule length of Black gram and Horse gram under various treatments.

Treatments	Germination %		Black gram		Horse gram	
	Black gram	Horse gram	Radicle	Plumule	Radicle	Plumule
T1 (control)	62.00	56.75	5.30	7.51	6.10	8.20
T2	98.00	99.00	4.88	7.92	6.10	9.50
T3	88.75	96.25	5.97	7.22	5.30	10.50
T4	87.50	98.75	5.45	7.66	5.50	9.20
T5	80.00	95.75	5.60	6.62	5.90	8.50
T6	68.75	50.00	4.10	4.78	3.00	6.80
T7	38.75	46.25	3.38	4.33	5.00	5.90
Mean	74.82	77.53	4.95	6.57	5.27	8.37
CV% (σ)	26.848	32.296	18.492	22.004	20.575	18.962

Any two means differ significantly from each other at P=0.05

Conclusion

From the above discussion it can be concluded that significant variation was found between the Black gram and Horse gram in all aspects. The higher concentration of IAA showed very least elongation of plumule as this higher concentration always inhibited the plumule elongation. GA_3 10 ppm showed highest germination percentage as well as the higher radical and plumule length in contrast to other treatments. But in case of radicle and plumule elongation, these hormones did not show any significant effect in both the crops. This indicates that the lower concentration of growth regulators favour the increased enzymatic activity which leads to the favourable environment for the germination as well as the growth of the radicle and plumule.

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