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Evaluation of Seed and Seedling Emergence Enhancement of Some Population of Sahandy Savory (*Satureja sahendica*) by Gibberlic Acid, Potasium Nitrate, Pre-cooling, Physical and Chemical Scarification Treatment

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Abstract: In greenhouse experiment, the seed samples of 3 populations were treated with treatments including: cold stratification, Gibberlic Acid (50 ppm and 100 ppm), Potassium nitrate (0.2%, 0.4%), physical scarification (sand paper), chemical scarification (Ethylic alcohol 70%) and distilled water (control), then these treated seed samples were sown in pots as randomize design with three replication. The germination characteristics including: germination percentage, speed of germination, length of root and shoot, seedling length, ratio of root length by shoot length, vigor index, fresh weight and dry weight, ratio of dry weight by fresh weight were evaluated during 45 days of experiment. Comparing between three populations of Sahandy savory, seed germination characteristics of the Ghazvin population was higher than the other two populations. According to effect of treatment on germination seed characteristics, the species of savory and their population, it was concluded that effect of Gibberlic Acid and Potassium nitrate was higher than physical scarification and chemical scarification comparing with control. With more effective of gibberlic acid and KNO_3 and cold treatment on seed germination enhancement of the population, it was clarified that the type of dormancy of some population of Sahandy savory was physiological dormancy.

Key words: *Satureja sahendica*, seed dormancy, cold, giberellic acid, potassium nitrate, physical and chemical scarification, germination, vigor index

INTRODUCTION

The use of plants as medicine approach requires that this group of species should be used to multiply and grow. In addition for their use as drugs and prevent of them from, physical and genetic erosion, they should be conserved. Cultivation and domestication of plants were begun with the movement of human civilization (Zargary, 1997).

The scientific name is Sahandy Savory is *Satureja sahendica*. It is shrub species, cushion with multiple stems to 12 to 25 cm tall, thin, arc, rising from the base of branches, with dense leaves, covered with simple and to crack down are curved. Leaves over 5 to 12 and to within 1 to 3 mm at the base narrow, without petiole with the sharp and more or less rounded, entire plicate texture of thick, gray in color and covered with large follicle red adherent and are short rough white. Inflorescence leaves are almost similar to the leaf stalk (Jamzad, 2010). The geographical distribution of this species in Iran includes the provinces of Azarbaijan, Zanjan, Kurdistan, Kerman shah. Habitats such as rocky slopes - rocky height of the Iran Region from 1300 to 2500 m is Turan (Jamzad, 2010).

Symbol of The United Nations World Food Organization is heading of wheat and therefore it is showing the value of seed and as reproductive organ of the plant.

Moreover the seeds is a rich source of carbohydrates, protein and oil in a very simple and digestible and storage of genetic modification through variation and plant breeders are transferred to farmers and gardeners (Tvakol Afsharyi *et al*., 2009). Two roles of the seeds are important in agriculture and horticulture because firstly, as an essential factor for proliferation and are considered for the starting point for many crops and secondly, the final product would be seed when it harvested by producer. The harvested crops include a range of seeds and it has varied products which directly used in human and animal nutrition.

The seeds are maintained in "gene banks" or "germplasm banks" at temperature of -20°C for a long time with 5% moisture content. Under these conditions, seeds of many of crops would be preserved their commercial viability for many years (Rahimian and Kosravy, 1999).

Plant growth regulator materials have been known as main agent of breaking dormancy of seeds. Gibberlic acid

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has important role in this type of materials. In order to breaking of dormancy potasium nitrate (0.2%) would be used (Dezfoly and Alikhany, 1999).

Given the importance of seed plants in the natural resources of gene banks, enhancement of seed germination and vigor of three populations Sahandy savory were studied with using physical and physiological seed treatments in 2010-2011.

MATERIALS AND METHODS

Six hundred seeds from three populations Sahandy savory was investigated in the greenhouse. The seeds were disinfected with liquid fungicides of vitawax tiram 1% for 5 min. Treatment including chilling treatment (4 weeks at 4°C), physical Scarification (abrasive paper) and chemical Scarification (alcohol), use of hormone gibberellic acid (50 and 100 ppm) and potassium nitrate (0.2%, 0.4%) were compared by control. For the greenhouse experiment, seeds were sown in pots and temperature 30-20°C and 10000 lux of light during the day and 12-5°C were at night. Percentage and emergence rate of seeds after 3, 6, 9, 12, 15, 18 and 21 days, were recorded. Seedlings growth was complete for 45 days. The germination characteristics including: germination percentage, speed of germination, length of root and shoot, seedling length, ratio of root length by shoot length, vigor index, fresh weight and dry weight, ratio of dry weight by fresh weight were evaluated during experiment. According to Maguire (1962), the speeds of germination were calculated by flowing equation:

$$GS = \frac{\sum n}{\sum n(n \times DN)} \times 100$$

where, n is the number of seeds germinated on day Dn, Dn is the number of days from sowing, corresponding to n and the highest G.S. is the fastest speed. The vigour index is a measure of seedling performance, which relates together the germination percentage of a seed sample and the growth of the seedlings produced after a given time (Abdul-Baki and Anderson, 1973). It is calculated by following equation:

$$Vi = \frac{\%Gr \times MSH}{100}$$

Where:
Vi = Vigour index
%G r = Final germination percentage
MSH = Mean seedling height

The data were analyzed by factorial experiment with the software of Minitab13.311 and Sas.

RESULTS

Analysis of variance showed that was significant at 1% level between populations for all traits but the percentage emergence and emergence rate and root to shoot ratio was significant at the 5% level. Between population and treatment, there were significant differences for all traits except for dry weight and fresh weight. Also Between treatment, there were significance differences for all traits p = 1% but for dry and fresh weight it was significant differences p = 5% (Table 1). Comparing of mean germination characteristics of three population Sahandy savory showed that population of Ghazvin had higher germination characteristics than the Bijar1 and Bijar2 (Table 2).

Seed emergence percentage and Speed of emergence rate: Effect of treatment on seed emergence percentage of three population of sahandy savory proved that seed emergence percentage of Bijar2 was maximum as 95% by effect of cold treatment compare with treatment of sand

Table 1: Mean square of seed emergence characteristics of population, treatment and interaction between them for *S.sahandica* in greenhouse condition

Name of sources	Df	Emergence	Speed of germination	Shoot length	Root length	Seedling length	Root length /shoot length	Vigor index	Fresh weight	Dry weight	Dry/fresh
Population	2	602.9*	7.6*	3062**	106.7**	4268**	0.037*	1601**	6475**	35.2**	0.014**
Treatment	14	6214**	110.8**	398**	17.1**	488**	0.028**	1113**	747*	10.6*	0.018**
Population* treatment	21	1650**	27.4**	131*	21.9**	210**	0.032**	213**	505ns	4.3ns	0.015**
Error	7	152	2.4	58	4.6	62	0.009	81	277	4.8	0.001
CV		22	24	27	28	22	33	42	49	59	35

*, **: Respectively significance 5 and 1%

Table 2: Mean comparison seed emergence characteristics of three population *Satureja sahandica* in greenhouse condition

Name of population	Emergence (%)	Speed of germination/day	Seedling length (mm)	Vigor index	Fresh weight (mg)	Dry weight (mg)
Bijar2	49.6^{b}	5.8^{b}	24.5^{c}	13.7^{b}	27.4^{b}	2.7^{b}
Bijar3	53.8^{a-b}	6.6^{a-b}	29.3^{b}	18.6^{b}	20.0^{b}	2.7^{b}
Ghazvin	59.7^{a}	6.0^{a}	51.6^{a}	30.5^{a}	53.0^{a}	5.0^{a}

Means of each columns followed by the same letters had no significant differences (P = 0.05) based on DMRT method

Table 3: Mean Comparison seed emergence characteristics of three population *Satureja sahandica* with effect of treatment in greenhouse condition

Name of population	Treatment	Emergence (%)	Speed of germination/day	Speed of germination/day	Seedling length (mm)	Vigor index	Fresh weight (mg)
Bijar2	ALCOL	20^{l-y}	2.42^{o-t}	19.53^{n-v}	4.45^{r-t}	20^{j-y}	2.66^{g-l}
	Cold	94.67^{a-c}	9.34^{d-h}	29.1^{g-q}	26.81^{b-n}	30^{f-s}	2.37^{h-l}
	Control	30.67^{p-y}	$3..41^{l-t}$	20.7^{m-v}	7.86^{p-t}	18^{k-y}	4^{d-l}
	GA100	93.33^{a-d}	14.04^{a}	26.4^{i-s}	25.26^{d-o}	23^{i-y}	3.5^{e-l}
	GA50	93.33^{a-d}	$10..81^{a-e}$	30.26^{f-p}	28.1^{b-l}	23.33^{h-y}	3.33^{e-l}
	KNO2	22.67^{e-y}	2.11^{p-t}	22.8^{l-u}	5.84^{q-t}	34^{f-o}	2.33^{h-l}
	KNO4	21.33^{t-y}	1.88^{p-t}	19.8^{m-v}	4.09^{p-t}	41.67^{f-k}	2.66^{g-l}
	Scraf	$21..33^{t-y}$	2.40^{p-t}	29.14^{g-q}	7.4^{p-t}	27^{g-x}	1^{l}
Bijar3	ALCOL	10.67^{w-y}	1.17^{s-t}	14.06^{p-w}	1.54^{s-t}	8^{p-y}	1^{l}
	Cold	40^{l-w}	3.49^{l-t}	31.26^{f-o}	12.54^{k-t}	16.33^{l-y}	1^{l}
	Control	28^{t-y}	2.84^{n-t}	29.06^{g-q}	8.11^{p-t}	18^{k-y}	2^{i-l}
	GA100	100^{a}	13.35^{a-b}	43.6^{c-h}	43.6^{a-b}	38.33^{f-l}	4^{d-l}
	GA50	98.67^{a}	12.95^{a-c}	37.2^{f-l}	36.62^{a-g}	30.67^{f-r}	3^{f-l}
	KNO2	33.33^{o-y}	3.95^{k-t}	32.8^{f-o}	11.04^{l-t}	22.67^{i-y}	3.5^{e-l}
	KNO4	96^{a-b}	11.89^{a-d}	28.4^{h-r}	27.28^{b-m}	11.33^{n-y}	4^{d-l}
	Scraf	24^{s-y}	3.21^{m-t}	12.7^{r-w}	2.36^{s-t}	12^{n-y}	
Ghazvin	ALCOL	36^{m-x}	4.27^{k-s}	40.86^{e-j}	14.69^{j-t}	34.33^{f-n}	3.66^{e-l}
	Cold	82.67^{a-g}	8.36^{d-j}	27.6^{h-r}	23.73^{a-p}	29^{f-t}	1^{l}
	Control	$49..33^{j-t}$	5.54^{j-p}	57.86^{a-c}	28.29^{b-k}	68.6^{a-d}	4.66^{c-l}
	GA100	62.67^{e-o}	7.21^{e-k}	63.3^{a}	42.51^{a-c}	74.6^{a-b}	7^{a-h}
	GA50	73.17^{a-k}	10.35^{b-g}	64.96^{a}	46.07^{a}	67.27^{a-e}	7^{a-h}
	KNO2	80^{a-h}	8.48^{d-j}	61.13^{a}	46.88^{a}	73^{a-c}	8.33^{a-d}
	KNO4	65.33^{c-m}	7.46^{e-k}	33.93^{f-n}	22.75^{f-q}	23.33^{h-y}	4^{d-l}
	Scraf	28^{t-y}	3.43^{l-t}	55^{a-e}	16.74^{h-t}	46.67^{d-i}	3.66^{e-l}

Means of each columns followed by the same letters had no significant differences (p = 0.05) based on DMRT method

paper and alcohol which produced seed emergence percentage as rate of 20-22%. Seed emergence percentage of Bijar3 was 99% and 100% by effect of gibberlic acid 50 ppm and 100 ppm but the minimum seed emergence percentage was 24% by effect of scarification of sand paper. Maximum seed emergence percentage of population of Ghazvin was 83%by effect of cold treatment but it was minimum as rate of 28% with sand paper treatment. By effect of gibberlic acid 100 ppm, Speed of emergence rate of Bijar3 was 13 sprout/day and it was higher than other treatment but the minimum Speed of emergence rate was 1 sprout/day with sandy paper treatment. Speed of emergence rate of Ghazvin was 10 sprout/day but the minimum Speed of emergence rate was 3 sprout/day with sandy paper treatment. By effect of gibberlic acid 100 ppm, Speed of emergence rate of Bijar2 was 14 sprout/day and it was higher than other treatment but the minimum of that was 2 with effect NO_3 k 0/1% and 0.2% (Table 3).

Seedling length and vigor index: Comparing of seedling length and vigor index of three population showed that the seedling length and vigor index of Ghazvin population 52 mm and 31 was higher Bijar2 and Bijar3. With effect of gibberlic acid 50 ppm seedling length of Bijar2 (31 mm) was maximum but with alcohol treatment, it was (21 mm) which was lower than control and the other treatment. Also the vigor index of Bijar2 was increased by gibberlic acid and cold treatment compare with other treatment. By effect of cold treatment and gibberlic acid 100 ppm ,the vigour index and seedling length of Bijar3 were 44 and 44 mm but with physical scarification both of them were lower than control and the other treatment. With effect of and gibberlic acid 100 ppm, seedling length of Ghazvin population was 96 mm which was higher than other treatment but lowest one was cold treatment as 28 mm. Also vigor index of Ghazvin population by was more by effect of gibberlic acid and potasium nitrate but it was lower by effect of alcohol.

Fresh and dry weight of seedlings: Fresh and dry weight of seedlings of Ghazvin population as 53 and 5 mg was higher than Bijar2 and Bijar3 population. By effect of gibberlic acid 100 ppm, Fresh weight of Bijar3 population was 38 mg and it was higher than other treatment. With effect of effect of gibberlic acid 100 ppm, Fresh weight of the seedlings of population was 75 mg mad it was higher than the other treatment. Dry weight of seedlings Bijar 2 population was 4 mg on untreated seed but it was minimum on sand paper treatment. With effect of effect of gibberlic acid 100 ppm and KNO_3 0/4 was maximum as 4 mg and it was lower with cold and alcohol treatment as 1 mg. Dry weight of seedlings of Ghazvin population by KNO_3 0/2% treatment was 8 mg and it was minimum as 1 mg with cold treatment.

DISCUSSION

Comparing of mean seed germination characteristics of sahandy savory showed that Ghazvin population had

higher of emergence percentage and high emergence speed than the other two population. Effect of cold gibberlic acid and Potassium nitrate treatment on mean seed germination characteristics of three population of Sahandy savory were more than control and other treatment but it was lower by physical scarification (sand paper) and alcohol treatment. This result was similar with result of Alizadeh *et al*. (2012), Hossienpour Ghazveni (2011) and Rahmanpour and Majd (1999) because they reported that using of cold treatment, hormone of gibberlic acid and Potassium nitrate were induce to increase of root and shoot length (seedling length) and vigour index.

With regard of result it was proved that the cold treatment caused the emergence percentage and emergence speed, seedling length and vigour index of Bijar2. This result was confirmed by Alizadeh and Isvand (2004). They reported that the seed germination characteristics of the of medicinal plant species of (*Anthemis altissima* were increased with cold treatment. With regard of increasing of gibberlic acid on fresh and dry weigh of population of sahandy savory, the same result was obtained by Farajpour *et al* (2010) for the species of *Achilla* . Also the same result was achieved by Tavily *et al*. (2010) for the species of *Salsola rigida.*

CONCLUSION

Regarding of result and discussion it was proved that seed germination characteristics of Ghazvin population was higher than two population of Bijar2 and Bijar3. Comparing effect of different treatment , gibberlic acid and KNO_3 and cold treatment were more effective on seed germination enhancement compare with control, physical and chemical scarification. Also with more effective of gibberlic acid and KNO_3 and cold treatment on seed germination enhancement of the population it was clarified that the type of dormancy of the population of Sahandy savoury was physiological dormancy.

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