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STUDIES ON GA_3 AND KNO_3 IN TWO BIOTYPES OF *Asphodelus tenuifolius* Cav. COLLECTED FROM KARAK AND MIANWALI, PAKISTAN

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ABSTRACT

Asphodelus tenuifolius Cav. (onion weed) is a notorious weed of sandy soils and observed as a serious weed of Rabi crops including chickpea, wheat, rapeseed and mustard. Dormancy is an overwhelming success attribute in onion weed. Weed seed dormancy is regulated by complex interaction of environmental, edaphic, physiological and genetic factors. Lab. studies were initiated in Weed Science Department, NWFP Agricultural University, Peshawar Pakistan during 2005 to investigate the response of Asphodelus tenuifolius to dormancy breaking chemicals, GA_3 and KNO_3 at 0 to 800ppm under room temperature. There were 3 runs of experiments viz. September 27, October 19 and November 1, 2005. Experiment was laid out in completely randomized design replicated twice. Each treatment comprised of a single petri dish planted with 20 seeds. The germinated seeds were subsequently converted to percentage. The germination percentage was subjected to ANOVA and means were separated by LSD test. The data revealed that the runs were extremely different from one another. Only 28% germination was recorded in the first run as compared to 91% and 86% in the second and the third run, respectively. The biotype Karak germinated slightly more (70%) as compared to the Mianwali biotype collected from Punjab. The biotype Mianwali biotype reached a climax of its germination in the second run, while Karak biotype had 100% germination in the November 1 run. The biotype x chemical x run interaction showed the highest germination in Karak treated with GA_3 during the first run, but the response of the biotype Mianwali was differential. It is concluded from our data that GA_3 was more potent in inducing germination of both biotypes and the seeds received germination signals, as the season advanced towards winter.

Key words: Dormancy, onion weed, sandy soils, Northwest Frontier Province, Punjab

INTRODUCTION

Onion weed, *Asphodelus tenuifolius* Cav. (Asphodelaceae) is the worst weed of sandy soils reproducing only by aerial bulblets and has been observed as a serious weed of rabi crops including chickpea, wheat, rapeseed, mustard and canola. Dormancy introduces a temporal delay in the germination process that provides additional time for

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seed dispersal over greater geographical distances. Weed seed dormancy and germination are regulated by a complex interaction of environmental, edaphic, physiological, and genetic factors (Radosevich *et al.*, 1996). Seeds that are released from the plant in a dormant state are said to exhibit primary dormancy while seeds that are released from the plant in a non-dormant state but which become dormant if the conditions for germination are unfavorable exhibit secondary dormancy. In order to break dormancy we come across two types of seed dormancy, coat-imposed dormancy and post harvest dormancy. Many seeds lose their dormancy when their moisture content is reduced to a certain level by drying (after ripening).Chilling seeds to break their dormancy is a time-honored practice in horticulture and forestry referred to as stratification. Many plants having very small seeds require exposure to light to overcome physiological dormancy. Seed of this type must be on or near the soil surface in order to germinate. Seed dormancy can result from lack of gibberellins or cytokinin in a seed as well as from an excess of an inhibitor hormone. Embryo dormancy is thought to be due to the presence of inhibitors, especially ABA, as well as the absence of growth promoters, such as GA (gibberellic acid). The loss of embryo dormancy is often associated with a sharp drop in the ratio of ABA to GA.

Dhindwal *et al.* (1989) conducted field trial to check efficiency of pre- and post-em. herbicides for control of *C. album, A. tenuifolius, C. arvensis* and *P. minor* in wheat. Sharma and Singh (1989) reported that *C. rotundus, A. tenuifolius, C. album* and *A. arvensis* were the predominant weeds of wheat comprising 68.52% of the total weed population. Ruiz *et al.* (1990) confirmed that *A. tenuifolius* was genetically less variable than *A. fistulosus* (2n = 28 in both species). Diaz and Lifante (1991) evaluated the morphological, palynological and karyological characters of *A. fistulosus, A. tenuifolius* and *A. cirerae*. Sahai and Bhan (1991a) examined *A. tenuifolius* seeds germination in laboratory experiments showing maximum germination at 15°C and most rapid germination at 20°C. They also deciphered the effect of environmental conditions on the growth and reproduction of *A. tenuifolius* in screen-house trials (Sahai and Bhan, 1991b). Tomar and Namdeo (1991) conducted Field trials on sandy loam soil in the Rabi seasons to evaluate 7 methods of control against mainly *A. tenuifolius, Chenopodium sp.* and *C. arvensis* in mustard. Poonia and Gupta (1993) conducted field trials in which onion weed was identified as *S.sclerotiorum.* Malik *et al.* (1994) conducted a survey of the weed flora in the major chickpea and raya, *C. album, A. tenuifolius, E. dracunculoides* and *T. polycera* were the dominant weeds of both crops. Diaz and Vades (1995) studied the reproductive biology and hybridization in *A. fistulosus, A. tenuifolius* and *A. ayardii. A. fistulosus* and *A. tenuifolius* were autogamous plants resulting from controlled self pollination while *A. tenuifolius* and *A. ayardii* forming no fruit. Diaz and Aquinalde (1996) applied RAPD analysis on *A.tenuifolius* and showed the highest interpopulation variability. Patterson (1996) evaluated environmental factors that affect the growth and development of onion weed in different crops. Ishwar *et al.* (2000) conducted a field experiment to identify suitable herbicides for the management of onion weed in Indian mustard. Caudra *et al.* (1996) reported increased germination in GA_3 incubated seeds. Dormant seed of *A.fatua* lacked the ability to synthesize or release gibberellin in amounts sufficient to allow germination when imbibed in water (Simpson, 1965). The exogenous application of GA_3 breaks dormancy (Naylor and Simpson, 1961). Ninnemann *et al.* (1964) show that nitrites or nitrite-induced germination is inhibited by CCC, an inhibitor of gibberellin biosynthesis. Adkins *et al.*, 1986 exhibit the differences between the pure lines exist in their sensitivity to GA_3 after induction of secondary dormancy determined by both genotype and the duration of after-ripening.

Keeping in view the importance of occurrence of dormancy in onion weeds, an experiment was undertaken to investigate the behavior of different dormancy breaking chemicals under the ambient conditions in the laboratory in the Department of Weed Science, NWFP Agricultural University, Peshawar, Pakistan. .

MATERIALS AND METHODS

The seeds of onion weed (*Asphodelus tenuifolius* Cav.) were collected from different locations in Pakistan viz. Sara Kewa district Karak and Pai Khel district Mianwali, Pakistan, during April 2005 from the chickpea based cropping areas. The experiment was undertaken under the controlled environment by subjecting the seeds to different temperature regimes, GA_3 and KNO_3, Laboratory studies were initiated in Weed Science Department, NWFP Agricultural University Peshawar, Pakistan during 2005 to investigate the response of onion weed (*Asphodelus tenuifoilius*) seeds to GA_3 and KNO_3, at 0 to 800 ppm exposed separately to room temperature. The experiment under laboratory condition was undertaken on 27th Sept, 9th Oct. and 1st Nov. Seventy two years data shows the maximum and minimum temperatures at Peshawar during the month of September and October as 42 and 12 ° and 38.3 and 8.3° C, respectively. The seeds were kept in petridishes in laboratory under room temperature for 4 weeks and the data were recorded on germination. Experiment was laid out in completely randomized design. This experiment has been runned 3 times and replicated 2 times, comprised of a single petri dish planted with 20 seeds. The germinated seeds were subsequently converted to percentage germination data. The germination percentage data were subjected to ANOVA technique and the means were separated by LSD test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Investigations were undertaken at the Department of Weed Science, NWFP Agricultural University, Peshawar, Pakistan on dormancy breaking chemicals GA_3 and KNO_3 for breaking the dormancy of onion weeds, *Asphodelus tenuifolius* seeds. The ANOVA revealed that the differences were significant ($P \leq 0.05$) for chemicals x concentrations, biotypes x concentrations, chemicals x runs, biotypes x runs, biotypes x chemicals and biotypes x chemicals x runs. Although, non-significant statistically, for the dormancy breaking chemical concentrations, the highest germination was recorded in untreated check (72.08%) and it was closely followed by 200ppm (71.45%). While, the lowest germination was recorded in 800ppm (65.16%) [Table-1]. Among the chemicals, statistically higher germination (72.0%) was recorded in GA_3 as compared to 64.0% germination as observed in KNO_3. For the interaction of chemicals x concentrations, the highest germination was recorded in the untreated check under GA_3 application (83.33%). It was however, statistically equal to 200 and 400ppm of GA_3 (Table-1). For the chemical x concentration interaction, the lowest germination was recorded in GA_3 applied at 800ppm, which however was statistically comparable with 600ppm under the same chemical (67.92%) and all the interactions involving KNO_3 (Table-1).

Table-1. Chemical x rates interaction for inducing germination in A. *tenuifolius*

Concentrations (ppm)	GA_3	KNO_3	Conc. Means
0	83.33a	60.83cd	72.00
200	77.50ab	65.42bcd	72.00
400	73.33abc	61.25cd	68.00
600	67.92bcd	60.42cd	64.00
800	58.33d	71.67abcd	65.00
Chemical Means	72.00	64.0	

Analysis of variance of the data showed that concentration x run, had significant effects on germination (Table-2). Among concentrations, although non-significant statistically, the highest germination 72.0 and 71.0% was recorded at 0 and 200 ppm respectively, while the lowest germination 64.0 and 65% as recorded at 600 ppm and 800 ppm, respectively. Whereas, among the runs, the highest germination (91%) was recorded in seeds of onion weed planted on 9th October while the lowest germination was recorded in the September experiment (Table-2).

Table-2. Rates x Runs interaction for inducing germination in A. *tenuifolius*.

Concentrations (ppm)	27 Sep.	9 Oct.	1 Nov.	Conc. Means
0	31.88cd	90.00a	94.38a	72.0
200	31.88cd	95.63a	86.88a	71.0
400	25.00d	90.63a	86.25a	67.0
600	13.13e	89.38a	90.0a	64.0
800	38.13c	88.13a	68.75b	65.0
Run means	28.0	91.0	85.0	

Statistical analysis of the data showed that biotypes x concentration interaction had a non-significant effect on the germination (Table-3). Among biotypes, higher germination (70.0%) was recorded in seeds collected from Karak while the lower (66.0%) germination was recorded in Mianwali. For the interaction of biotypes x concentrations, the highest germination (75%) and (73.33%) was recorded in Karak biotype at 800 ppm and 200 ppm. Closer readings were recorded for most of the interactions involving either genotype.

Table-3. Biotypes x Rates interaction for inducing germination in *A. tenuifolius*.

Concentrations (ppm)	Karak	Mianwali	Conc. Means
0	71.66	72.50	72.00
200	73.33	69.58	72.00
400	65.41	69.16	68.00
600	65.41	62.91	64.00
800	75.0	55.0	65.00
Biotypes means	70.00	66.00	

The statistical analysis of the data further reveals that chemical x run had significant effect on the germination (Table-4). Among the chemical higher value (72.0) was recorded for GA_3 while lower germination (64.0) was observed for KNO_3. Among the runs, the higher germination (91.0) was recorded in the 2nd run however it was statistically at par with the 3rd run (86%) that was tried in the month of November. Among interaction of chemical x runs, the highest germination (96.75) was observed in GA_3 treated seeds in 2nd while the lowest value (18.75) was observed for KNO_3 in the 1st run that was seeded in the month of September (Table-4).

Table-4. Chemical x Runs interaction for inducing germination in *A. tenuifolius*.

Chemical	27 Sep.	9 Oct.	1 Nov.	Chemical Means
GA_3	37.25c	96.75a	82.25b	72.00
KNO_3	18.75d	84.75b	88.25ab	64.00
Runs Means	28.0	91.00	86.00	

Analysis of variance of the data showed that biotypes x chemical interaction had non significant effect on germination (Table-5). Among the interactions, the highest value (75.33 %) was recorded in Karak biotype treated with GA_3 while lowest germination (62.82%) was also observed in same biotype subjected to KNO_3

Table-5. Biotypes x Chemical interaction for inducing germination of *A. tenuifolius*.

Biotypes	GA_3	KNO_3	Biotypes Means
Karak	75.33	65.00	70.00
Mianwali	68.83	62.83	66.00
Chemical Means	72.00	64.00	

The data for the 3-way interaction of biotypes x chemicals x concentrations had a significant effect on germination (Table-6). Among the interactions, the highest germination (84.17%) was recorded in Karak biotype treated with GA_3 at 0 ppm however, it was statistically at par with the rest of the concentrations in the same chemical. While in Mianwali biotype the highest germination (82.50 %) each was recorded in the Mianwali and Karak biotypes treated 800 ppm and 200 ppm GA_3, respectively (Table-6)

Table-6. Biotypes x Chemicals x Rates interaction for inducing germination in *A. tenuifolius*.

Biotype	Chemical	Rates (ppm)				
		0	200	400	600	800
Karak	GA_3	84.17a	82.50ab	70.83abc	70.83abc	68.33abc
	KNO_3	59.17bc	64.17abc	60.00bc	60.00bc	81.67ab
Mianwali	GA_3	82.50ab	72.50ab	75.83ab	65.00abc	48.33c
	KNO_3	62.50abc	66.67abc	62.50abc	60.83abc	60.67abc

The data in Table-7 exhibit the interaction of biotypes x runs x concentrations. The differences however were non-significant statistically. The data show that the lowest germination% (11.25) was found in Karak in Sep 1 Run treated either with 400 or 600 ppm. While, the highest germination% (100 each) was also found in Karak in Nov 1 Run across all the concentrations. The Mianwali biotype performed well at the intermediate rates however (Table-7).

Table 7. Three–way interaction of Biotypes x Runs x Rates interaction for inducing germination in *A. tenuifolius*.

Biotype	Runs	Rates (ppm)				
		0	200	400	600	800
[illegible]	Sept. 2[illegible]	[illegible]	28.2[illegible]	11.25	[illegible]	[illegible]
	[illegible]	[illegible]	33.7[illegible]	[illegible]	[illegible]	[illegible]
	Nov. 1	100.0	100.0	100.0	100.0	10[illegible]
[illegible]	Sept. 2[illegible]	36.25	37.50	38.[illegible]	16.0	42.5[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] interaction of chemicals x runs x concentrations [illegible] KNO3 treated [illegible] ppm [illegible] was found in GA at [illegible] Run treated at 200 and 400 ppm (Table 8). The KNO3 during first run across all the concentrations [illegible]

Table 8 Three–way interaction of chemical x runs x rates interaction for inducing germination in *A. tenuifolius*

Chemicals	Runs	Rates (ppm)				
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Sept. 27	56.75	55.0	40.0	[illegible]	[illegible]
	[illegible]	[illegible]	10[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Sept. 27	[illegible]	8.75	[illegible]	1[illegible]	[illegible]
	Oct. 19	85.50	91.25	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The data in Table 9 manifest the three way interaction of runs x chemicals x [illegible] results. The lowest germination [illegible] was found in K[illegible] treated with KNO3 [illegible] while the highest germination [illegible] was [illegible] found in Karak [illegible] GA and KNO3 (100.0 [illegible]). The differences [illegible] significant statistically.

Table-9. Three–way interaction of Biotypes x Runs x Chemicals interaction for inducing germination in *A. tenuifolius*.

Biotypes	Chemical	Runs		
		27 Sep.	19 Oct.	Nov. 1
[illegible]	GA	26.00	98.00	100.0
	KNO3	1[illegible].00	[illegible]9.0[illegible]	[illegible]
[illegible]	GA	[illegible]	[illegible]	[illegible]
	KNO3	[illegible]	[illegible]	[illegible]

[illegible] was about 5 times higher at Nov. 1 run as compared to September 2[illegible] [illegible] September [illegible]

in the second run and then declined to 70.5% in Nov 1. The behavior of the two types seems to be different the different runs of experiments

The data presented above are in a great analogy with the previous work of Hassan and Khan (2005), Hassan and Khan (2004a&b) and Hassan *et al* (2004c)

Table-10. Biotypes x Runs interaction for inducing germination in *A. tenuifolius*.

Biotypes	Sep. 27	Oct. 19	Nov. 1	Biotypes Means
Karak	22.00e	88.50b	100.0a	70.00
Mianwali	34.00d	93.00ab	70.50c	66.00
Runs Means	28.0	91.00	86.00	

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