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THE EFFECT OF SEED PRIMING AND SOAKING DURATIONS WITH DI AMMONIUM PHOSPHATE (DAP) ON SEEDLING EMERGENCE AND MORPHOLOGICAL TRAITS IN OKRA (*Hibiscus esculentus* L.)

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Abstract

The experiment was conducted at Ornamental Horticulture Nursery of the University of Agriculture, Peshawar in July 2008 to study the effect of okra seed priming with different phosphorus concentrations (DAP) at various durations on seedling emergence and some related traits. The experiment was laid out in Randomized Complete Block Design in split plot arrangement, with three replications. Four DAP concentrations i.e. 0.5%, 1%, 1.5%, 2%with difference soaking durations from 0 to 48 hours with 4 hours interval. Germination percentage (%), survival percentage (%), number of days to emergence, number of days to first flowering, plant height (cm), were significantly affected by concentrations and soaking durations. Mean values showed that maximum germination percentage (70.49 %), maximum plant height (150.33 cm) was observed in plot in which seeds were soaked in 0.5% phosphate solution. It is concluded that phosphorus concentration of 0.5 % and soaking for 32hour are recommended for seed priming in okra.

Key words: Okra, di ammonium phosphate (DAP), soaking duration, morphological traits

Introduction

Okra **(***Hibiscus esculentus L.***)** is a fast growing; heat-loving tropical annual crop, found in the wild along the White Nile, belongs to the family *Malvaceae*. Okra originated in tropical Africa, was grown in the Mediterranean region, wild forms are also found in India. Okra is a popular summer crop (Baloch 1990).Flowers are cream colored and have the general shape and form of a hibiscus blossom except they do not splay out flat. Like other hibiscus blossoms the young tender pods are cooked in curries, stewed, and used in soups (Baloch, 1990).

In the past, seed priming was used by the farmers to fill gaps in dry areas where germination percentages are relatively less. In recent years, the use of priming has grown following participatory methods in India, Pakistan and Bangladesh (Harris *et al.*,1999; 2001). Priming decreases the time span between the emergence of the first and the last seedlings. Priming also increases the rate of emergence, hence the standability (Hil, 2004).

Phosphorus plays an essential role in all physiological and biochemical processes in plants. (Hartmann and Geneve, 2000). The amount of phosphorus in plants ranges from 0.05 % to 0.50 % of total dry weight (Bieleski, 1973)

Seed priming with phosphorus solution is supposed to be an effective way of promoting early seedlings growth in phosphorus-deficient soils and ensuring phosphorus supply through seed soaking (Valdes, 1987). Even in soils with sufficiently high phosphorus content, a seed soaked in phosphorus can be beneficial due to improved availability of the nutrient. (Scott *et al.,* 1991). The present experiment was therefore designed to determine the optimum concentration of di ammonium phosphate (DAP) for seed priming and its effects on emergence and morphological traits of okra plant.

Material and Methods

The experiment was conducted at Ornamental Horticulture of the University of Agriculture, Peshawar in July 2008. Seed of okra (var. Green Star), a local cultivar was used in this experiment

Soil Analysis

Before sowing, soil samples up to 25cm depth were taken randomly from different parts of the field and were analyzed in the Soil Science Laboratory at the University of Agriculture, Peshawar for chemical characteristics.

Table 1: Chemical characteristics of the experimental field soil

Electric conductivity	80.3ds m^{-1}
Organic matter	0.99 %
Nitrogen	0.81 ppm
P_2O_5	0.02 ppm
K_2O	43.3 ppm
pH	8.5

Field Preparation and method of sowing

Before seed sowing the field was properly ploughed, and then leveled to have efficient distribution of irrigation water. Then well rotten farm yard manure was added to the soil. The distance between the wide ridges was 60 cm, eight seeds were sown on its both sides of the ridge, and 30cm the distance between plants within the same ridge. Plot size was 0.5574 m^2.Total area under cultivation was 99.87m^2.The field was irrigated after sowing and the second irrigation was followed after a week. Sowing was done in first week of July 2008. Weeding was done manually when needed. No insecticides/pesticides were applied during the whole growing season in order to assess the potential of crop.

Experimental design

The experiment was laid out in Randomized Complete Block (RCB) design in split plot arrangement with three replicates. The DAP concentrations were allocated in the main plots, while the soaking durations of the seeds were distributed in the subplots There were two factors studied in this experiment, as follows

Factor A: The different concentrations of DAP (Di Ammonium Phosphate) that were kept in the main plot. i.e. 0.5, 1, 1.5, and 2 %

Factor B: The soaking period, that were kept in sub plots. Soaking period were from 0 to 48 hours with 4 hours interval (0,4,8,12,16,20, 24,28,32,36,40,44,48).

Germination percentage (%)

.The germination percentage was calculated by the following formulae:

$$\text{Germination percentage (\%)} = \frac{\text{Number of total germinated seeds}}{\text{Number of total seeds sown}} \times 100$$

Survival percentage (%)

The data was recorded on the basis of total number of plant survived out of the number of plants germinated.

The survival percentage was determined by the given formulae:

$$\text{Survival percentage (\%)} = \frac{\text{Total number of plant survived}}{\text{Total number of plant germinated}} \times 100$$

Number of days to emergence

The data was recorded on the basis of number of days required from sowing to emergence in 50% of the sampled plants in each plot.

Number of days to first flowering

Number of days to the first flowering was recorded by counting the number of days from sowing up to flowering in 50% of the sampled plants in each plot.

Plant height (cm)

The plant height was recorded on randomly selected plants in each treatment, from ground level to the tip of plants by means of meter rod, and average height of plant was calculated.

Results and discussion

Germination percentage (%)

The data related to the germination percentage (%) are given in table (1). The Statistical analysis of data showed that soaking of seed for various durations and different concentration of phosphate solutions had significant effect on germination percentage (%), while their interaction had no significant effect on germination percentage.

Table 1. Germination percentage (%) of okra seeds as affected by priming with different DAP concentrations for various soaking durations.

Soaking Durations (h)	DAP Concentrations (%)				
	0.5	**1**	**1.5**	**2**	**Mean**
0	57.66	55.71	55.19	54.11	55.67 k
4	60.86	58.81	56.87	55.40	57.99 j
8	63.25	61.09	58.83	57.64	60.21 i
12	67.30	65.73	62.03	61.23	64.07 g
16	70.84	67.47	64.54	63.68	66.63 f
20	74.68	71.50	67.27	66.34	69.95 d
24	79.66	75.01	72.55	71.59	74.70 c
28	81.92	79.62	75.20	74.66	77.85 b
32	83.68	81.78	79.72	78.76	80.99 a
36	77.99	75.32	72.76	71.75	74.46 c
40	71.65	69.98	66.82	64.82	68.32 e
44	65.53	64.10	61.01	59.76	62.60 h
48	61.37	60.32	57.88	57.14	59.18 ij
Mean	70.49 a	68.19 b	65.44 c	64.38 d	67.13

LSD value at $P \leq 0.05$ for different DAP concentrations = 0.80

LSD value at $P \leq 0.05$ for various soaking durations = 1.27

Means followed by the same letter are not significantly different using LSD test at 5% level of probability.

According to the mean values of the experimental results maximum germination percentage (70.49 %) was recorded by the seed soaked in 0.5% phosphate solution, followed by (68.19 %) seed soaked in 1% solution, while minimum germination percentage (64.38 %) was recorded by the seed soaked in 2% phosphate solution. In case of various soaking durations maximum germination percentage (80.99 %) was recorded when seed soaked for 32h, while minimum germination percentage (55.67 %) was recorded for un-primed seed (control). According to the interaction between seed priming with ADP and soaking durations the results exhibited that maximum germination percentage (83.68 %) was recorded by the seed soaked in 0.5% solution for 32hr, while minimum germination percentage (54.11 %) was recorded in un-primed seed treatment These findings are in agreement with Harris *et al*., (1999) who stated that soaking seed in water immediately prior to sowing (seed-priming), as a way of speeding up germination. they also mentioned that seed soaking had a significant effect on germination. Soaking seeds induces a range of biochemical changes in the seed that are required to start the germination process (breaking dormancy, hydrolysis and enzyme activation). Some or all of these processes that precede the germination are trigged by priming and persist following the re-desiccation of the seeds (Asgedom and Becker, 2001).

Survival Percentage (%)

In terms of the survival percentage (%) data, which are given in Table 2. showed that soaking of seed for various durations had significant effect on survival percentage %, while their interaction and different concentration of phosphate solutions had no significant effect on plant survival percentage (%).

Table 2.Survival percentage (%) of okra as affected by priming with different DAP concentrations for various soaking durations

Soaking Durations (h)	DAP Concentrations (%)				
	0.5 %	1 %	1.5 %	2 %	Mean
0	86.67	85.63	84.98	84.65	85.48 c

4	95.13	91.92	96.37	93.63	94.26 ab
8	95.30	95.25	97.53	92.97	95.26 a
12	95.43	96.12	94.77	98.23	96.14 a
16	99.37	99.75	97.05	92.37	97.13 a
20	94.18	99.63	92.33	97.73	95.97 a
24	95.43	95.73	97.97	96.87	96.50 a
28	99.18	97.77	94.60	98.23	97.45 a
32	99.30	99.12	97.97	97.30	98.42 a
36	98.73	92.50	92.27	89.43	93.23 ab
40	97.25	96.93	96.03	92.63	95.71 a
44	90.12	88.30	88.03	86.05	88.13 bc
48	79.93	83.03	85.50	58.63	76.77 d
Mean	94.31	93.98	93.49	90.67	93.11

LSD value at $P \leq 0.05$ for soaking durations = 6.60

LSD value at $P \leq 0.05$ for various soaking durations=0.70

Means followed by the same letter are not significantly different using LSD test at 5% level of probability

The mean values indicated that maximum survival percentage (94.31 %) was recorded when the seed soaked in 0.5% phosphate solution, followed by (93.98 %) for seed soaked in 1% solution, while minimum survival percentage (90.67 %) was recorded when the seed soaked in 2% phosphate solution. In case of soaking durations, the results clarified that the maximum survival percentage (98.42 %) was recorded when seed soaked for 32hr followed by (97.45 %) survival percentage in seed soaked for 28hr, while minimum survival percentage (76.77 %) was recorded for 48hr. According to their interaction between seed priming with ADP and soaking durations the results showed that the maximum survival percentage (99.30 %) was recorded by the seed soaked in 0.5% solution for 32hr followed by (99.12 %) survival percentage in seed soaked for 32hr in 1% DAP, while minimum survival percentage (58.33 %) was recorded in the seed soaked for 48hr in 2% DAP.

The probable reason for the above results could be that some pathogens are present inside the seed (embryo, cotyledons), while others are present in their tests as contaminants. When the seed is sown, these pathogens infect the young seedlings, hence decreasing seed germination percentage and plant do not survive.

Number of days to emergence

Table (3) showed that the maximum number of days to emergence (7.88) was recorded by the seed soaked in 2% phosphate solution followed by (7.69) for seed soaked in 1.5 % phosphate solution while minimum number of days to emergence (7.09) was recorded by the seed soaked in 0.5% phosphate solution, while in case of various soaking durations maximum number of days to emergence (9.56) was recorded by un-primed seed plot followed by (9.02) in seed soaked for 48hr, while minimum value (6.38) was recorded when seed soaked for 32hr. According to the interaction between seed priming with ADP and soaking durations the results showed that the maximum number of days to emergence (9.77) was recorded by the un-primed seed soaked (the control), followed by (9.70) in seed soaked for 48hr in 1.5% solution, while minimum number of days to emergence (6.08) was recorded in the seed soaked for 32hr in 0.5% phosphate solution (Table 3).

Table 3.Number of days to emergence of okra as affected by priming with different DAP concentrations at various soaking durations

Soaking Durations (h)	DAP Concentrations (%)				
	0.5	**1**	**1.5**	**2**	**Mean**
0	9.60	9.40	9.47	9.77	9.56 a
4	7.60	7.98	8.10	8.27	7.99 c
8	7.53	7.63	7.97	8.10	7.81 c
12	6.92	7.13	7.77	7.82	7.41 d
16	6.60	6.92	7.40	7.70	7.15 de
20	6.40	6.67	7.13	7.40	6.90 ef
24	6.27	6.43	6.93	7.10	6.68 fg

28	6.17	6.28	6.60	7.13	6.55 g
32	6.08	6.15	6.40	6.87	6.38 g
36	6.28	6.47	6.93	7.07	6.69 fg
40	6.67	7.03	7.23	7.47	7.10 de
44	7.70	7.97	8.23	8.50	8.10 c
48	8.40	8.77	9.70	9.20	9.02 b
Mean	7.09 c	7.29 bc	7.69 ab	7.88 a	7.49

LSD value at $P \leq 0.05$ for different concentration= 0.528

LSD value at $P \leq 0.05$ for various soaking durations = 0.34

Means followed by the same letter are not significantly different using LSD test at 5% level of probability

The results which are supported by Arif *et al.*, (2005), stated that in case of maize seed priming with Phosphorus solution, the number of days to reach 50 % germination was 10 days in the control treatment, while seed soaked in 1.5 % Phosphorus concentration solution took maximum number of days to germination (7.179),but lower concentration 0.5 % Phosphorus solution took (6.154) days to 50% germination. Scott and Blair (1989) mentioned the the Increased concentrations of phosphorus delayed seedling emergence of leek, this result may be due to the interruption the seed germination because of the fast bio-chemicals activities in seed.

Number of days to first flowering

The data presented in Table 4. indicating numbers of days to first flowering according to the mean values of the experimental results maximum (33.69) numbers of days to first flowering was recorded by the seed soaked in 2% phosphate solution followed by (33.08) numbers of days to first flowering for seed soaked in 1.5 % phosphate solution, while minimum numbers of days to first flowering (31.12) was recorded by the seed soaked in 0.5% phosphate solution. In case of various soaking durations maximum numbers of days to first flowering (39.28) was recorded by un-primed seed soaked plot followed by (36.17 in seed soaked for 48hr, while minimum (27.17) numbers of days to first flowering was recorded for 32hr. According to the interaction between seed priming with ADP and soaking durations the results showed that the maximum numbers of

days to first flowering (39.77) was recorded by the un-primed seed soaked plot followed by (39.53) numbers of days to first flowering in un-primed seed soaked plot, while minimum numbers of days to first flowering (25.63) was recorded in the seed soaked for 32hr in 0.5% phosphate solution.

Table 4. Number of days to first flowering of okra as affected by priming with different DAP concentrations at various soaking durations.

Soaking Durations (h)	DAP Concentrations (%)				
	0.5	**1**	**1.5**	**2**	**Mean**
0	38.47	39.37	39.53	39.77	39.28 a
4	34.90	35.72	36.02	36.95	35.90 b
8	33.63	34.27	35.11	35.74	34.69 c
12	30.55	32.01	33.04	34.10	32.42 e
16	29.04	30.42	32.47	33.07	31.25 f
20	28.20	29.33	31.38	32.13	30.26 g
24	27.73	28.62	30.33	31.03	29.43 h
28	26.50	27.43	28.47	29.10	27.88 i
32	25.63	27.13	27.80	28.10	27.17 i
36	28.10	29.50	30.50	31.10	29.80 gh
40	32.07	33.27	33.97	34.27	33.39 d
44	34.34	34.80	35.13	35.45	34.93 c
48	35.43	35.77	36.33	37.13	36.17 b
Mean	31.12 B	32.13 AB	33.08 A	33.69 A	32.51

LSD value at P≤ 0.05for different concentrations = 1.63

LSD value at P≤ 0.05 for various soaking durations = 0.76

Means followed by the same letter are not significantly different using LSD test at 5% level of probability

Days to flowering are generally used as a measure of maturity period. Days to flowering character is highly correlated with physiological maturity. It is considered as the termination of

vegetative cycle and start of reproductive cycle. Chemicals break the dormancy of the seeds. Growth hormones are released and the growth rate may become much faster than normal. The result is supported by Shitab and Khllil (2007) who stated that in case of wheat seed priming using different concentrations of phosphorous as a significant result on number of days to flowering. Harris *et al.*, (2001) reported that primed seed crop emerges fast, flowers earlier and gives higher yield.

Plant height (cm)

The mean values indicated that maximum plant height (150.33 cm) was recorded by the seed soaked in 0.5% solution followed by (147.70 cm) for seed soaked in 1% phosphate solution, while minimum plant height (136.52cm) was recorded by the seed soaked in 2% phosphate solution. In case of various soaking duration maximum plant height (168.56 cm)was recorded in seed soaked for 32hr followed by (163.03 cm) for seed soaked in 28hr, while minimum (114.42cm) plant height was recorded for control seed plot (Table 5). According to the interaction between seed priming with ADP and soaking durations the results exhibited that maximum plant height (182.63cm) was recorded when the seed soaked in 1% solution for 32hr followed by (176.77cm) plant height for seed soaked in 0.5% DAP for 32hr, while minimum plant height (112.43cm) was recorded in the un-primed seed soaked plot.

Table 5. Plant height (cm) of okra as affected by priming with different DAP concentrations at various soaking durations

Soaking Durations (h)	DAP Concentrations (%)				
	0.5	**1**	**1.5**	**2**	**Mean**
0	118.30	113.83	113.10	112.43	114.42 i
4	138.07	133.53	129.67	127.20	132.12 g
8	146.40	143.40	136.50	131.60	139.48 ef
12	149.47	146.13	141.60	135.57	143.19 e
16	158.73	154.73	147.50	138.30	149.82 d
20	162.63	158.57	152.37	143.60	154.29 cd
24	168.83	163.83	155.77	148.30	159.18 bc

28	173.60	170.53	157.71	150.27	163.03 b
32	176.77	182.63	161.37	153.47	168.56 a
36	151.53	149.93	154.43	142.90	149.70 d
40	148.23	144.87	133.57	138.10	141.19 e
44	140.90	139.60	126.23	133.00	134.93 fg
48	120.77	118.47	120.13	120.03	119.85 h
Mean	150.33 A	147.70 A	140.77 AB	136.52 B	143.83

LSD value at P≤ 0.05 for different concentration= 10.00

LSD value at P≤ 0.05 for various soaking durations = 5.15

Means followed by the same letter are not significantly different using LSD test at 5% level of probability

It is considered that plant height is an expression of its full vegetative potential. The enhanced plant height in primed seed plots may be due to improved and faster emergence in primed seed plots which created cooperative competition among the plants for light, water and nutrients and resulted in taller plants. Probable reason could be that priming might have increased seedling vigor, which enhanced the competitiveness for light, water and nutrients. The results are in agreement with the work of Rashid *et al*., (2006), who reported that seed priming has been shown to improve plant stands. Asgedom and Beaker (2001) also reported that Zn primed seeds showed higher vigor than unprimed seed as reflected in maximum plant height.

References

Arif, M., Ali, S., Shah, A., Javeed, N. & Rashid, A., 2005. Seed priming maize for improving emergence and seedling growth. *Sarhad J. Agric.* 21(4): 539-543.

Asgedom, H. & Becker, M., 2001. Effects of seed priming with nutrient solutions on germination, seedling growth and weed competitiveness of cereals in Eritrea, in proc. DeutscherTropentag, Univ. of Bonn & ATSAF, Margraf Pub. Press, Weickersheim. 2(4):282-286.

Baloch, A.F., 1990. Growth and yield performance of okra (*Abelmoschusesculentus* L.) cultivars. *Gomal Univ. J. Res.* 10(2):91-95.

Bieleski, R.L., 1973. Phosphate pools, phosphate transport, and phosphate availability. *Annu. Rev. Plant Physiol.* 24: 225–252.Hil, H.J., 2004 Invigoration of seed. Seed Sci. Tech. 3:881-888.

Harris, D., Joshi, A., Khan, P. A., Gothkar, P. & Sodhi, P. S., 1999. On-farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in india using participatory methods. *J. Cambridge*. 35 (01):15-29.

Harris, D., Raghuwanshi, B.S., Ganwar, J.S., Singh, S.C, Joshi, K.D, Rashid, A. & Hollington, P.A., 2001. Participatory evolution by farmers of on farm seed priming in wheat in India, Nepal, and Pakistan. *Exp. Agric*. 3(7):403-415.

Hartmann, T.H. & Geneve, L. R., 2000. Plant Propagation: Principles and Practices. Prentice Hall, New Jersey. 8(8):10-14.

Rashid, A., Hollington, P.A., Harris, D. & Khana, P., 2006. On-farm seed priming for barley on normal, saline and saline–sodic soils in North West Frontier Province, *Pak. Europ. J. Agro*. 24:276–281.

Scott. & Blair., 1989. Biochemical changes during priming of leek seeds through fertilizer based solution. *Ann. Bot*. 63: 185-193.

Scott, J.M, Hill, C.B. & Jessop, R.S., 1991. Growth chamber study of phosphorus applied as drilled granules or as seed coatings to wheat sown in soils differing in P-absorption capacity.*Fert.Res.*29**:**281-287.

Shitab, K. & Khalil, S. K., 2007. Effect of seed priming with phosphorus concentrations and application rates on wheat. A thesis submitted to NWFP Agricultural University, Peshawar.

Valdes, A.W., 1987 Effect of seed coating and osmotic priming on the germination of seeds. *J. Amer. Soc. Hort. Sci.* 11(2): 153–156.