

Studies on the Biology of New Emerging Broadleaf Weed *Malva neglecta* Wallr.

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ABSTRACT

Malva neglecta is a winter season weed and its seeds can germinate in Petri dish at a temperature range of 10-30°C but maximum seed germination was observed at 20°C in case of fresh, one season old and two seasons old seeds under scarified and unscarified seed conditions. Two seasons old weed seeds showed higher germination percentage as compared to one season old seeds followed by fresh seeds. Unscarified seeds showed significantly lower germination in comparison to scarified seeds at all temperatures in fresh, one season and two seasons old weed seeds. In pot experiment, weed seedlings emergence, height of weed plants, number of branches produced per plant and dry matter accumulation by weed showed an increasing trend with increase in ponding duration during preceding summer season. Least weed emergence and growth of weed was recorded in pots kept dry throughout the summer season and maximum weed emergence and growth was observed where ponding of water during summer months remained for four weeks followed by continuous moist throughout the season.

Key words : Button weed, pot experiment, temperature, ponding, summer season

INTRODUCTION

Among the dicot weeds affecting wheat crop, *Malva neglecta* Wallr. is a new emerging problematic weed. *M. neglecta* commonly known as common mallow/button weed/cheese plant/cheese weed belongs to mallow family (Malvaceae). It is a broadleaf winter annual. From the Alberta Agriculture weed alert reporting system, *M. neglecta* was identified as the 49th most abundant weed in major field crops with a maximum density of 6.8 plants/m² (Dexter *et al.*, 1981). So, to formulate any effective weed control strategy against this weed, the knowledge of its biology is of paramount importance to knock it out at the most vulnerable stage.

MATERIALS AND METHODS

Biology of *M. neglecta* was studied under two different experiments.

Experiment I : To Determine Optimum Temperature for Germination of *M. neglecta*

The Petri dish experiment was conducted in Weed Physiology Lab, Department of Agronomy, Punjab Agricultural University, and Ludhiana. For this fresh, one season old and two seasons old weed seeds were taken and the study was conducted under scarified and unscarified seed conditions. Sand paper was used for

scarification purpose and seeds were scarified until the outer papery shell was removed. Forty seeds each of these scarified and unscarified were placed in Petri dishes lined with moist filter paper and were incubated at 10°, 15°, 20°, 25° and 30±1°C in an incubator for 21 days. The treatments were replicated five times in a completely randomized design. The seed germination count was recorded every third day.

Experiment II : Effect of Ponding Duration during Summer on Germination of *M. neglecta*

The pot experiment was conducted at Students' Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana. The six treatments consisted of ponding for one week and then kept moist throughout the season (P₁+m), ponding for two weeks and then kept moist throughout the season (P₂+m), ponding for three weeks and then kept moist throughout the season (P₃+m), ponding for four weeks and then kept moist throughout the season (P₄+m), continuous moist throughout the season (M) and dry soil throughout the season (D). This experiment was conducted for two years in pots with four kg of soil capacity and pots were kept in open place. In pots 200 scarified and unscarified seeds were sown at a uniform depth of 2 cm. In first year of study (during 2004-05), seeds were sown in pots during summer season on June 9, 2004. The reason for sowing the seeds in summer was to see

the effect of ponding during summer on germination behaviour of this weed in subsequent winter as this weed is becoming problem in rice-wheat rotation where water ponding is a common practice during summer and it may have some effect on winter season weeds lying dormant in the soil. At maturity of weed plants, observations like height of plant and number of branches per plant were recorded and weed plants were harvested to take dry matter accumulation on April, 2005. After harvesting weed plants, the pots were further kept as such to see the germination of carry over seeds if any and also to observe the growth behaviour of plants. During second year of study (2005-06), again new experiment was started on June 10, 2005 and all the same treatments were repeated in this new experiment alongwith in the pots sown during 2004 to see the behaviour of carry over seeds of first year of study. The germination behaviour of carry over seeds was observed from the first year of study only. Treatments were replicated four times in completely randomized design.

RESULTS AND DISCUSSION

Effect of Temperature on Germination of *M. neglecta* (Expt. I)

The perusal of data presented in Table 1 reveals that lower weed seed germination was recorded at 10°C

temperature and germination increased upto 20°C. At 20°C, maximum germination was observed. Further, germination of weed seeds got reduced at 25°C and least germination was observed at 30°C in all seeds (fresh, one season old and two seasons old weed seeds) during first (2005) as well as second (2006) year of investigation. On an average basis, a maximum germination of 66.2, 77.1 and 92.4% was recorded at 20°C in case of fresh, one season old and two seasons old seeds under scarified seed conditions, respectively. At 30°C, a minimum germination percentage was observed under fresh, one season and two seasons old seeds and corresponding values were 8.7, 44.2 and 53.4%, respectively, in scarified seeds. Blackshaw (1990) also reported optimum germination of weed seeds between 15° to 20°C.

Two seasons old weed seeds showed higher germination percentage as compared to one season old seeds and fresh weed seeds at all the temperatures. Minimum germination was observed in fresh seeds. Makowski (1987) also reported that weed seeds showed a trend of increasing germination percentage from fresh to old age seeds. This might be due to the fact that fresh seeds have innate dormancy and require rest period before these germinate. In case of two seasons old weed seeds, there were significant differences between weed seed germination at the different temperatures.

It is clear from Table 1 that unscarified weed

Table 1. Effect of different temperatures on *M. neglecta* seed germination (%) under scarified and unscarified conditions

Temp. (°C)	Seed age								
	Fresh			One season old			Two seasons old		
	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
10-S	44.9 (50.0)	43.5 (47.5)	(48.7)	49.6 (58.1)	48.2 (55.6)	(56.8)	59.6 (74.3)	58.7 (73.1)	(73.7)
10-US	2.2 (0.62)	2.2 (0.62)	(0.62)	2.2 (0.62)	2.2 (0.62)	(0.62)	12.6 (4.8)	1.19 (4.3)	(4.5)
15-S	47.8 (55.0)	46.4 (52.5)	(53.1)	52.9 (63.7)	51.4 (61.2)	(62.4)	64.8 (81.8)	63.8 (80.6)	(81.2)
15-US	2.2 (0.62)	2.2 (0.62)	(0.62)	2.2 (0.62)	2.2 (0.62)	(0.62)	13.8 (5.7)	11.9 (4.3)	(5.0)
20-S	55.2 (67.5)	53.7 (65.0)	(66.2)	61.7 (77.5)	61.2 (76.8)	(77.1)	75.7 (93.7)	72.9 (91.2)	(92.4)
20-US	7.7 (2.5)	9.0 (2.5)	(2.5)	6.4 (2.5)	8.7 (3.1)	(2.8)	18.9 (10.6)	16.9 (8.7)	(9.6)
25-S	31.9 (28.1)	31.2 (26.8)	(27.4)	58.7 (73.1)	57.9 (71.8)	(72.4)	64.3 (81.2)	62.5 (78.7)	(79.9)
25-US	6.8 (1.8)	6.8 (1.8)	(1.8)	6.4 (2.5)	6.8 (1.8)	(2.1)	15.1 (6.8)	12.7 (5.0)	(5.9)
30-S	17.6 (9.3)	16.4 (8.1)	(8.7)	41.7 (44.3)	41.0 (43.1)	(44.2)	47.4 (54.3)	46.4 (52.5)	(53.4)
30-US	2.2 (0.62)	2.2 (0.62)	(0.62)	5.5 (1.8)	6.4 (1.2)	(1.5)	5.5 (1.8)	7.7 (2.5)	(2.1)
LSD (P=0.05) (Temp.)	3.8	3.1	-	4.1	3.3	-	-3.0	2.7	-
LSD (P=0.05) (S vs. US)	2.4	1.9	-	2.6	2.1	-	1.9	1.7	-

Figures in parentheses are original percentage values, data were transformed to arc sine transformation.
S-Scarified seed, US-Unscarified seed.

seeds showed a similar trend of germination as scarified seeds, but germination in case of unscarified seeds was significantly lower than scarified seeds at all the temperatures. A lower average germination (4.5 and 5.0%) of weed seeds was obtained at 10° and 15°C, maximum (9.6%) being at 20°C and then least (2.1%) at 30°C in the two seasons old weed seeds under unscarified conditions.

Data in Tables 2 and 3 envisage that under scarified and unscarified conditions maximum weed seeds germinated within seven days after sowing at temperature of 20°, 25° and 30°C. However, germination continued upto 13 days under scarified conditions, but under unscarified conditions, germination continued only upto nine days. For lower temperatures of 10°C and 15°C, no germination was observed within first five days, thereafter germination started and it took 17 days to complete germination under both scarified and unscarified seeds.

Effect of Period of Ponding on Germination of *M. neglecta* (Expt. II)

Emergence Count

The perusal of data in Table 4 reveals that, in

general, the seedlings emergence percentage increased with increase in duration of ponding during summer in both the years 2004-05 and 2005-06 alongwith carry over seeds from the previous season (2004-05). When soil was kept dry throughout season, least emergence of 0.23 and 0.23% was observed during 2004-05 and 2005-06, respectively. Whereas in carry over seeds of previous season (2004-05), emergence of 0.73% was observed under unscarified seed condition. Maximum seedling emergence was recorded in treatment where ponding condition remained for four weeks and then kept moist throughout the season. Seedlings emergence to the tune of 3.2 and 2.6% was recorded under scarified condition and only 2.1 and 1.8% seedlings emerged under unscarified conditions, during 2004-05 and 2005-06, respectively. The seedling emergence was higher in all the treatments in the carry over experiment of previous season as compared to new experiment during both the years of study. This might be due to the reason that with passage of time, seed dormancy breaks and leads to higher emergence of the weed. Significant differences were observed between seedling emergence in the scarified and unscarified treatment and also between different durations of ponding during 2004-05, 2005-06 and carry over of previous season (2004-05).

Table 2. Periodic cumulative germination of *M. neglecta* seeds (two years' mean) under different temperatures in scarified condition

Temp. (°C)	Days after sowing										Total germination (%)
	3	5	7	9	11	13	15	17	19	21	
10 °C											
Fresh	0	0	0	20.0	33.2	40.7	46.9	48.9	48.9	48.9	48.9
1 season old	0	0	0	33.2	46.9	50.1	55.1	56.3	56.3	56.3	56.3
2 seasons old	0	0	0	57.0	63.2	66.9	70.6	74.3	74.3	74.3	74.3
15 °C											
Fresh	0	0	0	20.0	38.7	44.9	53.6	52.4	53.6	53.6	53.6
1 season old	0	0	0	38.7	51.2	51.2	62.4	62.4	62.4	62.4	62.4
2 seasons old	0	0	0	62.0	74.5	74.5	81.5	81.5	81.5	81.5	81.5
20 °C											
Fresh	13.7	30.7	49.4	56.4	58.4	65.9	65.9	65.9	65.9	65.9	65.9
1 season old	35.7	55.2	70.9	73.4	74.6	77.1	77.1	77.1	77.1	77.1	77.1
2 seasons old	48.2	78.2	91.4	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6
25 °C											
Fresh	7.5	12.0	23.2	23.9	27.7	27.7	27.7	27.7	27.7	27.7	27.7
1 season old	25.0	40.7	64.9	66.9	72.6	72.6	72.6	72.6	72.6	72.6	72.6
2 seasons old	17.5	50.0	71.2	74.9	79.9	79.9	79.9	79.9	79.9	79.9	79.9
30 °C											
Fresh	5.7	7.7	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
1 season old	26.2	34.9	42.4	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9
2 seasons old	32.0	38.2	43.2	46.9	50.1	54.6	54.6	54.6	54.6	54.6	54.6

Table 3. Periodic cumulative germination of *M. neglecta* seeds (two years' mean) under different temperatures in unscarified condition

Temp. (°C)	Days after sowing										Total germination (%)
	3	5	7	9	11	13	15	17	19	21	
10 °C											
Fresh	0	0	0	0	0	0.75	0.75	0.75	0.75	0.75	0.75
1 season old	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
2 seasons old	0	0	0	0	3.75	4.50	4.50	4.50	4.50	4.50	4.50
15 °C											
Fresh	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75
1 season old	0	0	0	0	0	0	0	0.75	0.75	0.75	0.75
2 seasons old	0	0	2.00	3.25	4.50	5.25	5.25	5.25	5.25	5.25	5.25
20 °C											
Fresh	0	1.25	1.25	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
1 season old	1.25	2.00	2.00	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
2 seasons old	0.75	5.75	8.25	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50
25 °C											
Fresh	0	0	1.25	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1 season old	0	0.75	1.50	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
2 seasons old	0	4.50	5.25	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
30 °C											
Fresh	0	0	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
1 season old	0	0.75	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
2 seasons old	0	0.75	1.50	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25

Plant Height

With increase in ponding duration, height of weed plants showed an increasing trend both in scarified and unscarified conditions during both the years and also in carry over of the previous year. Ponding for four weeks and then kept moist throughout the season treatment produced significantly taller weed plants as compared to treatments of ponding for one week and kept moist throughout the season, moist throughout the season and dry throughout the season. But for 4, 3 and 2 weeks ponding duration treatments remained at par with each other. In the carry over seed experiment, plants were short as compared to plants in the new experiments. This might be due to the fact that in carry over experiment, the emergence was higher, so there were more plants leading to less plant height (Table 4).

Number of Branches

The more number of branches were recorded in first flush during 2004-05 and 2005-06 due to more vigorous growth of plant than in subsequent flush in the seed carry-over experiment where plant height was less and number of branches produced by weed were also

less (Table 4). Non-significant differences were obtained in number of branches between scarified and unscarified seeds and also between different ponding treatments.

Dry Matter Accumulation

As the ponding period increased, there was an increase in dry matter accumulation (Table 4). Significant differences were observed in dry matter accumulation between pots under scarified and unscarified weed seed conditions during 2004-05, 2005-06 and in carry over seed of previous season (2004-05). The differences for dry matter accumulation were also significant among treatments of four weeks, three weeks, two weeks, one week ponding, moist throughout the season and dry throughout the season.

Flower Initiation

The weed seedlings emergence in pots was recorded in the second week of August (14-15 Aug.) and first flower initiation was reported on 20th Jan. So, it took approximately 135 days for first flower. But in the carry over experiment, it took three days extra for flower initiation.

Table 4. Influence of different ponding treatments on seedling emergence, height, branches production and dry matter accumulation of *M. neglecta*

Ponding weeks	Seedling emergence (%)**		Height (cm)		Number of branches		Dry matter accumulation (g/pot)**		
	2004-05	2005-06*	2004-05	2005-06*	2004-05	2005-06*	2004-05	2005-06*	
P ₄ + m (S)	10.3 (3.2)	32.3 (28.4)	34.5	20.7	13.2	9.0	19.5 (4.52)	15.2 (4.01)	16.5 (4.17)
P ₄ + m (US)	8.2 (2.1)	28.7 (23.3)	32.2	19.5	12.5	8.6	13.7 (3.83)	10.3 (3.36)	12.5 (3.68)
P ₃ + m (S)	9.6 (2.8)	30.1 (25.2)	33.8	19.7	12.9	8.4	16.0 (4.12)	12.7 (3.70)	14.8 (3.97)
P ₃ + m (US)	7.4 (1.7)	26.6 (20.2)	31.2	18.2	12.2	7.9	11.9 (3.58)	8.8 (3.13)	10.9 (3.45)
P ₂ + m (S)	8.9 (2.4)	27.9 (22.0)	32.5	18.5	12.6	8.0	13.5 (3.81)	10.5 (3.39)	12.5 (3.67)
P ₂ + m (US)	6.5 (1.3)	24.5 (17.2)	30.2	17.5	11.9	7.7	9.8 (3.28)	7.7 (2.94)	8.5 (3.07)
P ₁ + m (S)	8.1 (2.0)	25.4 (18.6)	31.4	17.4	12.2	7.9	11.8 (3.55)	9.0 (3.14)	10.0 (3.31)
P ₁ + m (US)	5.6 (1.0)	22.0 (14.0)	29.8	16.4	11.6	7.5	7.2 (2.84)	6.6 (2.74)	6.5 (2.73)
M (S)	7.3 (1.6)	21.9 (14.1)	30.5	16.5	11.9	7.4	9.6 (3.23)	7.7 (2.93)	8.2 (3.02)
M (US)	4.2 (0.56)	18.8 (10.5)	29.0	15.5	11.4	7.0	5.0 (2.42)	5.4 (2.52)	4.2 (2.27)
D (S)	6.2 (1.2)	11.0 (3.7)	29.5	16.0	11.5	6.8	5.3 (2.50)	5.0 (2.44)	4.5 (2.33)
D (US)	2.7 (0.23)	4.8 (0.73)	28.0	15.0	11.2	6.4	1.6 (1.61)	4.1 (2.26)	1.1 (1.44)
LSD (P=0.05)	0.58	2.1	2.2	1.5	NS	NS	0.24	0.16	0.19
(ponding)									
LSD (P=0.05)	0.33	1.2	1.3	0.92	NS	NS	0.15	0.09	0.16
(S vs. US)									

*Carry over seeds of the previous season sown during 2004.

**Values in parentheses are original percentage values, data are transformed to arcsine transformation.

***Figures in parentheses are original values, data are transformed to $\sqrt{X+1}$ (sq. root).

P₄, P₃, P₂, P₁—Ponding for four, three, two and one week, respectively.

m—After ponding treatment, moist throughout season.

M—Moist throughout season.

D—Dry throughout season.

S—Scarified seeds.

US—Unscarified seeds.

Time of Flowering

The weed plants took 10-12 days to complete 50% flowering after the flower initiation.

Time to Maturity

Every flower took 10-12 days for button formation and further 10 days for maturity of seed.

Seedling emergence and all other growth parameters of this weed showed an increasing trend with increase in ponding duration during summer months. So, this study indicates higher infestation of *M. neglecta* in rice-wheat system where ponding during rice crop will encourage this weed in subsequent winter season.

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