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Influence of Floret Size, Lemma and Palea (Husk) on the Germination of *Avena fatua* Linn.

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Abstract: In *Avena fatua* the first and the second florets (seeds) can germinate together and separately. Seed coverings negatively influence the germination of all the three seeds present in the spikelet. The percentage of the third floret in the spikelet ranged from 18-79 depending on the amount of moisture present during seed formation.

Key words: *Avena fatua*, Seed germination, Lemma, Palea

Introduction

The economic importance of wild oats (*Avena fatua*) has prompted extensive research on its seed and survival (Somody *et al*., 1984). The early shedding of wild oats seeds on the ground, usually before or at the time of crop harvest allows the reinfestation of fields (Sharma and Vanden Dorn, 1978). Zorner *et al*. (1984) have quoted many authors who consider *A. fatua* notorious for its soil persistence. *A. fatua* plants emerging before the crop produced five times as many seeds per plant as those emerging between the crop at two and three-leaf stages (Peters and Wilson Arc, 1983). Seeds become viable before the onset of dormancy. Seeds may be dormant during the post harvest period or may achieve dormancy by exposure to adverse environmental conditions.

The mechanism of dormancy in wild oats has been studied by a number of workers. Opinions differ on the role of the husk or hull, consisting of lemma and palea, in dormancy of wild oats (Sharma and Vanden Dorn, 1978). There are views that removing the hulls completely or pricking the caryopsis through the enveloping hulls increased the germination of wild oats (Simpson, 1990; Thurston, 1962). Overall dormancy of seed produced at 15 and 20°C was 97 and 63%, respectively. Water stress and high temperature reduced viable seed production (Peters, 1982). Fresh seeds of most non-domesticated grasses are physiologically dormant, although morphologically mature (Groves, 1991).

Hasiao *et al*. (1983) are of the view that mechanical injury caused a localized increase in the potential of imbibed water thus stimulating the seed germination. In *A. fatua* the process of after-ripening is complex and under genetic control. Seed dormancy in *A. fatua* is caused by factors which prevent sufficient water uptake by the embryo for induction of germination (McIntyre and Hsiao, 1985). Wild oats usually have two to three seeds (florets) per spikelet but mainly two (Peters, 1985). Results of experiment conducted (Thurston, 1982) revealed that the small third seeds remain dormant longer than the larger first or second seed of the spikelet while there are reports, suggesting little innate dormancy in the basal seed of the spikelet (Wilson, 1985).

The present investigation was carried out to study the effect of the seed coverings on the germination of *A. fatua* and the sequence of germination of the seeds within the spikelets.

Materials and Methods

Seed characteristics: To determine the percentage of the spikelet containing the third seed 100 spikelets were counted from the seed lot collected during 1984 to 1989 and separated into florets. The percentage of the third floret present was determined. The seed from the main stem and tillers was not collected separately. Seed germination with and without lemma and palea: Ten seeds were sown in 9 cm petri dishes with 8 ml distilled water or in 100 gms of soil. The lemma and palea of half of the seeds was removed while in the rest were left intact. The germination was observed for 15 and 40 days for the seeds sown in petri dishes and soil respectively in a growth chamber at 20°C.

Seed germination in pots: Seeds were sown in pots in the green house (average temperature 25°C). The whole spikelet and the two separated seeds i.e. first and second were sown separately. The percentage germination was determined after 30 days of sowing.

Experiments were conducted during 1990 at National Agricultural Research Centre (NARC); repeated twice and the results were pooled. Seeds with different colours were found in the collections and were used as such. Most of the seeds were brown with very hairy lemmas.

Results and Discussion

Seed Characteristics: It was found that the third seed was present in all the seed collections from a 1984-89, with the percentage ranging from 18-79 (Table 1). The development of the third seed may depend on the climatic condition at the time of seed formation.

The presence of third seed varied with change in rainfall during seed formation. The average percentage of the third seeds was found to be 18, 20 and 31 with 54, 51 and 71 cms rainfall respectively. The rainfall for the two year where 79 and 69 percent of the spikelet had the third seed was 35 and 41 cm (Table 2) respectively. Seemingly high moisture during seed maturation does not allow the development of the third seed.

Seed germination with and without lemma and palea: The study where the husk was removed gave another view of *A. fatua*. The seed without lemma and palea germinated almost immediately. Even the 2nd seed showed a germination of 64% after 5 days and 86% after 15 days (Table 3). The third seed germinated to the extent of 29%, showing the importance of control of this noxious weed before seed formation. The gradual abrasion or decay of the seed coat during the years, enhances the seed germination or in other words the dormancy is broken. The results seem consistent with the hypothesis that seed dormancy in wild oats is due primarily to factors which prevent the imbibition of water by the embryo in an amount required to trigger the onset of germination (McIntyre and Hsiao, 1985) (Table 4).

In the soil the seeds took a longer time to germinate so the study was extended to 40 days. The seed incubated in petri dishes responded to dehulling by germinating more rapidly than intact

Table 1: Percent of *Avena fatua* spikelets with the third seed

Seed collection time	3rd seed (%)
1989	79
1988	18
1987	20
1986	31
1984	69

Table 2: Temperature (°C) and rainfall (mm) during the growing season

Year	Temperature		Rainfall total (mm)	Avg + (mm)
	Maximum	Minimum		
1983-84	22	9	286	41
1984-85	24	9	159	23
1985-86	23	9	495	71
1986-87	19	9	357	51
1987-88	21	9	378	54
1988-89	22	9	244	35

+ Average of 7 months (October-April)

Table 3: Germination percentage of *Avena fatua* seeds with and without lemma and palea in petri dishes

Days	Seed with lemma and palea			Seeds without lemma and palea		
	1st	2nd	3rd	1st	2nd	3rd
5	71	54	0	93	64	7
10	79	58	0	100	71	21
15	93	64	0	100	86	29

Table 4: Germination percentage of *Avena fatua* seeds in soil without lemma and palea

Interval in days	5	10	15	20	25	30
1st seed	51	56	58	60	62	64
2nd seed	10	10	10	10	10	10
1st + 2nd seed	53	62	63	63	63	63

Table 5: Rainfall in mm at seed formation

Year	January	February	March	April
1984	0.00	105.50	97.60	24.65
1985	52.00	11.20	37.50	33.00
1986	12.00	126.00	110.00	48.00
1987	0.10	113.00	69.00	41.00
1988	29.00	24.50	158.80	24.30
1989	60.00	15.60	75.40	6.00

seeds incubated in soil. The seed without the lemma and palea showed higher germination. The larger seed germinated 100% while the medium seed with coverings showed 80% and without coverings 100% germination.

Hsiao *et al*. (1983) are of the view that mechanical injury caused a localized increase in the potential of imbibed water thus stimulating germination. Simpson (1990) has quoted several workers where the lemma and palea definitely contribute to reduce the germinability. Many reports indicate that the lemma and palea together only delay and do not stop water uptake to the caryopsis. The examination of the behaviour of excised embryos in different gaseous environment suggest that dormancy is not just a reflection of hull and seed coat impermeability to oxygen (McIntyre and Hsiao, 1983).

Adkins and Simpson (1988) observed that dehulling the seeds prior to after ripening reduced the duration of dormancy. The mechanisms underlying the dormancy do not appear to reside within the embryo. Isolated embryos of dormant lines are capable of germination at optimum temperature, but are thermodormant at relatively high temperature (Sawhney, 1989).

Mechanical wounding broke dormancy and promoted germination of primary dormant pure-line *A. fatua* caryopsis that were in the first physiological stage of dormancy and caryopsis incubated in petri dishes responded to wounding by germinating more rapidly than wounded caryopsis incubated in soil (Foley, 1987).

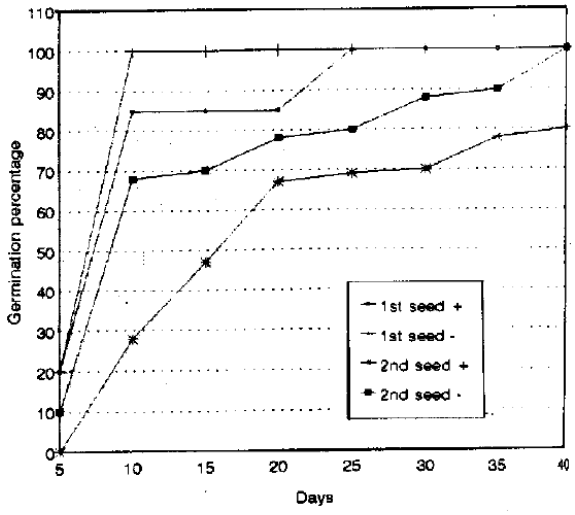

Fig. 1: Germination of *A. fatua* seed with or wothout lemma and palea in pots

Seed germination in pots: The pattern of emergence of the first floret when the florets are separated from the spikelet or when they are attached is almost the same (Table 3). Five days after sowing 51% of the first seed germinated, increasing to 64% after 30 days. The second seed gave a constant 10% germination. The first or the large seed is mostly dominant, however the two seeds can grow together even when attached.

Thurston (1982) is of view that *A. fatua* seeds fall separately as they ripen because each floret has an abscission scar at its base. In Pakistan the crops are found to be contaminated by the intact spikelets, as well as the florets (Fig. 1, Table 5).

The large seed has advantage over the others in germination capability. Seedlings emerging in the first autumn must come from seed with little innate dormancy; most likely the basal seeds of the spikelet (Peters, 1982).

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