THINK INDIA JOURNAL

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Floret selection and diurnal anthesis timing for effective seed set in oat crossing in North-Western Himalayan region

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***Keywords**:Diurnelanthesis, common oat, stigma receptivity, seedset**,**artificial pollination*

Abstract

This study reports an effective protocol for increasing the rate of seed set in common oat under North- Western Himalayan region. Emphasis was given on the selection of florets and the time of pollination. Highest seed set was observed for the combination when the uppermost five florets were used as the seed parent and pollination was done in the evening between 1700-1830 hours when the oat plants undergo their natural diurnal anthesis.

Introduction

Common oat is a hexaploid cereal crop which is used both as animal feed and for human consumption. It is an annual cool season grass crop adapted mainly to the moist areas of the temperate climates of the world(Hoffman, 2012).All wild and cultivated species of oats of various ploidy levels are predominately self-pollinated (Brown, 1980). Creation of variability by artificial pollination is a critical step in the genetic improvement of any crop(Allard, 1960; Bernardo, 2002). The act of performing artificial pollinations is a laborious process and the efficiency of the seed set is often poor in oat(Brown &Shands, 1957).There has been no detailed report providing guidelines for making the best out of the artificial transfer of pollen and increasing the effective hybrid seed set in North-Western Himalayan region in common oat and this paper provides important insights for the same.

Material and methods

a. Materials

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The experimental material for the study included seven oat genotypes viz. PLP 1, HJ 8, Kent, RO 19, OS 6 and HFO 114

Genotypes used as a pollen source: PLP 1 and HJ 8

Genotypes used for emasculations: Kent, RO 19, OS 6 and HFO 114

Location: Palampur, HP (32° 6' 37.9512" N and 76° 32' 10.4064" E.)

Year: *rabi*2016-17

b. Method of emasculation and pollination

Oat spikelets from the six genotypes were selected from the top part of the panicle and emasculated before onset ofanthesis in the same phase of development as when the panicles were growing out of the leaf sheath. Emasculation were performed during morning between 0800-1100 hours. Secondary and tertiary florets were discarded and only the primary florets were used for emasculation per spikelet. The florets were kept uncut and gently opened using a pair of forceps starting with the glumes and then lemma and palea. The anthers were then gently pulled out with the help of the forceps making sure that all the three anthers were removed. Extreme care was taken to avoid any touching or injury to the stigma of the floret. Barring the emasculated florets, all the other spikelets were cut using a pair of scissors. The emasculated panicles were covered with butter paper bags to maintain humidity and avoid stray pollen followed by labelling of tags with information viz., date of emasculation and genotype name.

For pollination the emasculated florets were cut horizontally across the centre.An entire floret was detached from the panicle of the genotypes serving as a pollen source. This was done while the floret opened and extended its filament. The floret was held from the base and the pollen was shed on the emasculated and cutflorets.

Results

The results are present the table 1. For control, pollination protocol pertaining to wheat was also followed in oat viz. anther place inside the oat floret during morning hours. Data has been provided for pollination attempts during morning and evening.

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The selection of florets and their number was also observed to have a considerable effect on increasing the rate of seed set (Table 2). The highest percentage of seed set was observed when the number of florets was limited to five per main tiller. The five florets were the uppermost florets. In case of the random selection of florets on the panicle and increasing their number to 15 or more lead to a decrease in the percentage of seed set.

Discussion

Oats differs from other small grain temperate cereals as its inflorescence is in the form of a panicle while in wheat, barley and rye the inflorescence is in the form of a spike (Misonno, 1936). Another peculiarity of oats is that while the anthesis in wheat, barley and rye occurs early in the morning, the diurnal anthesis timing in oat during late afternoon (Misonoo, 1936; Bonnet, 1961). In the Palampur(32° 6' 37.9512" N and 76° 32' 10.4064" E.) region of North-Western Himalayan region observation in the field showed that while wheat, rye and barley protrude anthers in the morning around 0700-0900 hours, Oats bloom at 1700-1830 hours. During this period the florets of oat open at an angle in excess of 30° and the filaments of the anthers elongate while shedding pollen. The quality and quantity of pollen during this natural time of diurnal anthesis is maximum and hence is the best time for pollen collection and attempting artificial cross pollination. The same was observed in the present study were the rate of seed set was greater during natural diurnal anthesis timing of oat.

The spikes of wheat, barley and rye complete the entire anthesis across their inflorescence in three days; roughly starting from the central florets and moving bidirectionally towards the peripherals (Brown, 1980; Bonnett, 1961). The same process in oat is a complicated and is prolonged to up to 12-15 days (Misonoo, 1936; Bonnett, 1961). The anthesis starts in the topmost single floret on the first day and progresses downwards with the number of florets going

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into anthesis increasing with every passing day. This extended period of blooming of florets in oat must be taken into consideration for effective utilization of stigma receptivity. The number of florets selected for doing pollination have to be done in such a way that on a single day of crossing on a plant the emasculated florets also correspond to natural blooming time. The limited selection of florets in the uppermost part of the inflorescence helps in the effective targeting of maximum stigma receptivity.

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Table 1: Seed set percentage for different anthesis timings

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Genotypes		Morning (0800-0100)			Evening (1700-1830)		
		Florets pollinated	Seed Set		Florets pollinated	Seed Set	
Female	Male	no.	no.	%	no.	no.	%
Kent	PLP 1	107	3	2.80	201	77	38.31
Kent	HJ 8	98	7	7.14	340	108	31.76
RO19	PLP 1	134	4	2.99	170	67	39.41
RO19	HJ 8	113	0	0.00	255	95	37.25
OS6	PLP 1	105	12	11.43	195	65	33.33
OS6	HJ 8	76	2	2.63	244	86	35.25
HFO114	PLP 1	110	0	0.00	276	65	23.55
HFO114	HJ 8	88	0	0.00	198	67	33.84

Table 2: Seed set percentagefor different florets selected

Genotypes		Top 5 florets selected			Random 15-20 florets selected		
		Florets pollinated	Seed Set		Florets pollinated	Seed Set	
Female	Male	no.	no.	%	no.	no.	%
Kent	PLP 1	67	45	67.16	134	38	28.36
Kent	HJ 8	75	43	57.33	265	103	38.87
RO19	PLP 1	45	31	68.89	125	48	38.40
RO19	HJ 8	67	35	52.24	188	43	22.87
OS6	PLP 1	76	34	44.74	119	25	21.01
OS6	HJ 8	34	12	35.29	210	39	18.57
HFO114	PLP 1	87	29	33.33	189	39	20.63
HFO114	HJ 8	60	23	38.33	138	32	23.19