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Short Communication

Influence of gamete selection for wilt resistance in the F_1 generation on the variability of non-target quantitative traits in F_2 generation of chickpea

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Chickpea (*Cicer arietinum* L.) despite its broad adaptation, production is restricted by several biotic and abiotic stresses. Among biotic stresses, *Fusarium* wilt caused by *Fusarium oxysporum* f.sp. *ciceris* is the major limiting factor for chickpea productivity. The best strategy to manage this disease is through use of resistant cultivars. Gamete selection is effective technique, which can be easily combined with conventional methods to develop resistant varieties in short time [1-3]. By artificially imposing various selective pressures during the process of gamete formation and fertilization in the F_1 generation, one can increase the frequency of plants with the targeted trait. The application of gamete selection for wilt resistance has increased the frequency of resistant plants in segregating population [1]. Gamete selection may produce resistant plants but there are chances that it may result in low productivity due to linkage drag. The present study was undertaken to analyze effect of gamete selection for wilt resistance on segregation and variability of non-targeted quantitative traits in the F_2 generation.

Two genotypes - Karikadle, a highly susceptible (early wilter) and BG-256 susceptible (late wilter) - were crossed to highly resistant genotype, WR-315 to produce 2 sets of hybrids. The two sets of F_1 plants of each cross were grown during 2008. The plants were closely monitored and at flower bud initiation stage, one set of F_1 plants of each cross were sprayed with a fungal pathotoxin, fusaric acid (Sigma) at a concentration of 2500 µg/ml [1]. Likewise, another set of F_1 plants were sprayed with water as control. The flowers of both toxin and water sprayed F_1 plants were selfed to generate F_2 seeds. The seeds obtained from toxin treated and control F_1 plants were harvested separately to produce seeds of treated F_2 and control F_2 populations respectively. The F_2 seeds were grown during late *rabi* 2009 at the Agricultural Experimental Station, UAS Dharwad. Each F_2 population was grown in a plot size of 3m x 2m (10 rows of 2 m length) in a single replication. The plants were spaced 30 cm between rows and 10 cm within the row. Each parental line was planted in 3 rows and 2 m length in a continuous block. In tota,l 92 and 102 plants respectively of treated and control F_2 populations of cross BG-256 x WR-315 and 80 and 64 plants respectively in treated and control F_2 populations of cross Karikadle x WR-315 were used for recording observations on the quantitative traits *viz.,* plant height at harvest (cm), number of branches per plant, number of pods per plant, test weight (g) and seed yield per plant (g).

The mean values of control and treated F_2 populations of respective crosses were compared using t-test. Further the respective control and treated F_2 populations were compared for their distribution using KS-test after calculating frequency distribution.

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The control and treated F_2 populations were assessed for wilt reaction using linked markers - CS 27_{700} linked to H_1 and $A07_{417}$ linked to H_2 loci of wilt resistance. It was observed that the treated populations showed deviation from expected monogenic and digenic ratios producing more number of resistant plants. However, the control F_2 produced the expected ratios for the linked markers confirming the earlier reports [1]. The comparison of mean values of control and treated F_2 populations revealed that plant height and test weight did not differ significantly in both the crosses (Table 1 and 2). On the other hand, the number of pods per plant showed significant difference between control and treated F_2 populations. In both the crosses, the control F_2 population had a higher mean number of pods per plant compared to corresponding treated F_2 population. In the earlier studies also gamete selection for disease resistance has influenced other quantitative traits in sunflower [2]. Similarly in the cross Karikadle x WR-315 the seed yield per plant and number of branches per plant also recorded significant difference between control and treated F_2 populations. However there was no improvement in the treated F_2 for these traits due to gamete selection for wilt resistance. Similar non-response to gamete selection for quantitative traits has been reported [4, 5]. In fact gamete selection for wilt resistance resulted in reduction of mean performance of several quantitative traits. In general, the treated F_2 populations of both the crosses produced lower range for all the traits compared to control F_2 populations. The lower range in treated F_2 populations can be expected as the selection was made for wilt resistance. *In vivo* selection of pollen using fusaric acid has lead to elimination of susceptible pollen grains. Such selection gives advantage only to pollen grains with resistant alleles there by reducing the variation in pollen grains resulting in reduction of variation for non-targeted traits in the treated F_2 population.

Along with range, genotypic coefficient of variation (GCV) and phenotypic coefficient of variations (PCV) were also computed to compare variability of different characters in control and treated F_2 populations. Knowledge on the heritability and genetic advance are important to a plant breeder since it indicates the possibility and extent to which improvement is possible through selection. The relative amount of heritable portion was assessed in the present study which revealed that traits test weight, seed yield per plant and plant height showed higher heritability in both control and treated F_1 populations of both the crosses. The gamete selection in general did not show any effect on the heritability and genetic advance of all the traits studied in both the crosses.

The KS-test showed differences between control and treated F_2 populations in the cross BG-256 x WR-315 (Table 3). On the other hand, the control and treated populations did not differ for any of the traits studied in the other cross. Results indicated that probably gamete selection for wilt resistance in the F_1 for wilt resistance not only influenced the segregation of wilt resistance but also other characters. In chickpea there are no

Table 1. The mean, range and components of variance of different characters in control and treated F_2 populations for cross BG-256 x WR-M5

Trait	Population	Mean	Range	GCV	PCV	h^2	GA
1. Plant height (cm)	Control F_2	35.73	26-48	9.18	14.56	39.8	4.26
	Treated F_2	39.01	30-55	8.94	14.45	38.2	4.07
	t-test	NS					
2. Number of branches	Control F_2	3.44	2-10	22.61	43.92	26.5	0.83
	Treated F_1	2.59	2-4	24.19	44.45	29.6	0.94
	t-test	NS					
2. Number of pods per plant	Control F_2	23.52	3-51	46.53	67.00	48.2	15.66
	Treated F_2	22.92	1-56	47.79	69.15	47.8	15.57
	t-test	S					
4. Test weight (g)	Control F_2	16.46	10.00-32.90	19.56	21.96	79.3	5.91
	Treated F_2	16.05	10.20-23.35	17.29	20.18	73.4	4.99
	t-test	NS					
5. Seed yield per plant (g)	Control F_2	3.58	1.06-13.77	50.71	55.70	82.9	3.41
	Treated F_2	3.37	0.84-8.46	51.95	57.15	82.6	3.47
	t-test	NS					

NS=Non Significant S= Significant

Table 2. The mean, range and componenets of variance of different characters in control and treated F_2 populations for cross Karikadle x WR-315

Trait	Population	Mean	Range	GCV	PCV	h^2	GA
1. Plant height (cm)	Control F_2	32.96	21-41	11.86	14.78	64.4	7.12
	Treated F_2	32.29	25-39.2	9.88	14.56	46.0	4.97
	t-test	NS					
2. Number of branches	Control F_2	2.64	2-4	19.93	41.83	22.7	0.75
	Treated F_2	2.42	2-7	22.78	43.65	27.2	0.88
	t-test	S					
3. Number of pods per plant	Control F_2	23.31	2-68	39.05	64.97	36.1	11.54
	Treated F_2	16.00	2-50	47.16	68.62	47.2	15.83
	t-test	S					
4. Test weight (g)	Control F_2	13.01	10.00-18.00	18.67	21.22	79.3	5.91
	Treated F_2	13.06	10.15-18.20	17.29	20.45	73.4	4.99
	t-test	NS					
5. Seed yield per plant (g)	Control F_2	2.41	0.77-14.80	46.98	54.15	75.3	2.95
	Treated F_2	1.64	0.78-11.20	53.47	58.76	82.8	3.62
	t-test	S					

NS = Non Significant; S = Significant

Table 3. Comparison of control and treated F_2 populations of chickpea for five quantitative traits using KS-test

Trait	Karikadle x WR-315	BG-256x WR-315
1. Plant height	D=0.025	D=0.283*
2. Number of branches per plant	D=0.012	D=0.108*
3. Number of pods per plant	D=0.000	D-0.040*
4. Test weight	D=0.053	D=0.028*
5. Seed yield per plant	D=0.012	0=0.074*

*indicate significant difference between control and treated F_2 populations

studies on the association of wilt resistance with other quantitative studies to draw any valid conclusions. The results are based on only a limited number of plants and require validation on larger population size and more number of crosses to draw any valid reliable conclusions on the effect of gamete selection on the segregation non-targeted traits.

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