



Detergent-induced male sterility in chickpea (*Cicer arietinum* L.)

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Chemical induction of male sterility has been considered desirable because it has the potential to provide for the development of hybrids directly out of elite germplasm without the time and effort required to transfer male sterility and fertility restore genes. The newer generation of chemical hybridizing agents are found to be much more useful with increasingly better selectivity and effectiveness [1]. Evaluation of some anilates as the potential chemical hybridizing agents have been successfully done in chickpea [2, 3]. In recent years, some synthetic detergents e.g. Nirma and Surf Excel have been successfully used to induce male sterility in several crops [4, 5]. Keeping this in view, the efficacy of Surf Excel in three varieties of chickpea (*Cicer arietinum* L.) was evaluated.

Present experiment was conducted on chickpea (*Cicer arietinum* L.) var. Rachna, Radhey and Pusa-256. The seeds of these varieties were shown at the Botanical Garden, School of Life Sciences, Dr. B. R. Ambedkar University, Agra. The plants thus raised were sprayed with aqueous solutions of Surf Excel (0.5, 1.0 and 1.5 % w/v), sodium carbonate and sodium phosphate (0.25, 0.50 and 1.0% w/v) at different developmental stages. Solutions were prepared by dissolving these chemicals in distilled water using a magnetic stirrer. A group of 90 plants were sprayed a week before floral bud initiation (T₁). Leaving 30 plants for T₁ treatment, the other 60 plants were sprayed again three days after first treatment (T₂). A group of 30 plants receiving two treatments (T₂) were sprayed third time at the time of anthesis (T₃). Individual plant was sprayed with 15 ml of concerned solution to run off. A group of 90 plants were sprayed with distilled water to serve as control (T₀). The flowers of some treated and untreated plants were bagged to check the pollen fertility and seed-set. Pollen fertility was tested at regular intervals throughout the flowering period with 1% aetocarmine. Ovular sterility was checked by making reciprocal crosses between treated and untreated plants. Data on the days taken to first flowering, pollen fertility, number of fruits/plant, total yield and 100 seed weight were obtained

from treated and control plants and were analyzed by ANOVA. The data of various parameters obtained from three varieties used in this experiment were more or less similar. Therefore, the data obtained from variety "Rachna" has been shown in Table 1.

Days taken first flowering: Single treatment with 0.5% Surf Excel induced early flowering. All other treatments with Surf Excel, sodium carbonate and sodium phosphate delayed flowering. The maximum delay in the flowering was recorded in plants treated thrice with the highest concentrations of Surf Excel, sodium carbonate and sodium phosphate.

Pollen sterility: Foliar sprays with different concentrations of Surf Excel induced pollen sterility ranging between 82-100% (Table 1). Two to three sprays with 1.0% and all the treatments with 1.5% Surf Excel induced complete pollen sterility lasting for 15-20 days. Sprays with sodium carbonate and sodium phosphate, the chief components of the detergent were also found to be effective in inducing complete pollen sterility. There were no seed-set in bagged flowers of treated plants, confirming complete pollen sterility.

Number of fruits and total yield/plant: The number of fruits and total yield/plant decreased with the increase in the concentration and number of treatments of Surf Excel, sodium carbonate and sodium phosphate (Table 1). There was a significant reduction in total yield/treated plant with all the three chemicals. However, it was interesting to note that plants treated only once with 1.5% surf excel showed minimum reduction on yield in all the three varieties. However, this was not at par with that of control plant (23.7 g). The minimum reduction in yield (20.5 g) was recorded in the plants treated once with 0.25% sodium phosphate.

100 Seed weight: Various treatments with different concentrations of Surf Excel, sodium carbonate and sodium phosphate also brought about reduction in 100 seed weight (Table 1). However, it was interesting to note that plant treated thrice with 1.5% Surf Excel

Table 1. Effect of Surf Excel, sodium carbonate and sodium phosphate on various reproductive parameters in chickpea (*Cicer arietinum* var. Rachna).

Concentrations (%)		Chemicals								
		Surf excel			Sodium carbonate			Sodium Phosphate		
		0.5	1.0	1.5	0.25	0.50	1.0	0.25	0.50	1.0
Days taken to first flowering	T ₀		106.0			106.0				106.0
	T ₁	100.3	110.6	113.0	106.0	107.6	112.0	104.0	105.0	110.3
	T ₂	106.6	112.6	114.0	109.3	112.8	112.8	108.7	110.6	112.9
	T ₃	112.3	113.3	114.6	112.0	113.0	113.3	113.0	113.3	114.0
CD value at 5% level		3.5			3.0			3.2		
Pollen sterility	T ₀		3.8			3.8			3.8	
	T ₁	82.0	87.0	100.0	92.0	100.0	100.0	85.0	92.0	100.0
	T ₂	98.6	100.0	100.0	95.0	100.0	100.0	86.0	100.0	100.0
	T ₃	100.0	100.0	100.0	100.0	100.0	100.0	95.0	100.0	100.0
CD value at 5% level		1.8			1.7			1.8		
Number of fruits/plant	T ₀		127.6			127.6			127.6	
	T ₁	88.0	78.3	74.3	98.3	92.5	92.0	100.0	97.3	94.2
	T ₂	69.3	66.6	65.0	93.6	88.7	80.3	86.0	84.3	79.0
	T ₃	58.3	55.0	53.0	68.8	65.0	62.1	65.0	63.5	62.0
CD value at 5% level		5.1			5.0			5.2		
Total yield/plant (g)	T ₀		23.7			23.7			23.7	
	T ₁	14.4	14.8	15.3	20.2	19.5	18.8	20.5	19.6	19.2
	T ₂	13.2	13.5	13.8	19.5	19.0	18.5	19.8	19.4	19.0
	T ₃	12.9	13.3	11.7	18.7	18.6	18.2	19.5	19.2	18.9
CD value at 5% level		1.6			1.6			1.2		
100 seed weight (g)	T ₀		18.5			18.5			18.5	
	T ₁	13.3	16.3	17.1	19.2	17.0	16.8	19.5	16.2	16.0
	T ₂	14.5	16.9	18.2	18.6	16.5	16.5	18.8	16.0	15.5
	T ₃	19.1	19.3	20.2	18.5	16.0	16.0	18.4	15.2	15.0
CD value at 5% level		1.2			1.6			1.2		

T₀ = Plant sprays with distilled water, T₁ = Single spray before bud initiation, T₂ = Double spray, first before bud initiation and second after two three days bud initiations, T₃ = Triple spray, first before bud initiation, second after bud initiation and third at the time of anthesis.

exhibited an increase in 100 seed weight (20.2g) as compared to control plants (18.5 g). The increase in fruit and seed size is attributed to the fact that there was a reduction in the number of fruits/treated plants. On the other hand, plants treated with sodium carbonate and sodium phosphate caused significant reduction in 100 seed weight.

From the foregoing observations it is evident that all the treatments with lower concentration of surf excel and its components viz., sodium carbonate and sodium phosphate are capable of inducing complete pollen sterility in all the three varieties of chickpea. The plants treated thrice with the lower concentration of Surf Excel (0.5%) and sodium carbonate (0.25%) and all the treatments with 0.50% sodium phosphate are most suitable for the hybrid seed production because they exhibit complete pollen sterility with the least phytotoxicity with minimum reduction in yield parameters. Treatments with sodium carbonate and sodium phosphate inducing 100% pollen sterility, also clearly indicate that these ingredients of surf excel are basically responsible for inducing male sterility in chickpea.

Recently, foliar applications with surf excel have not only induced complete pollen sterility in various crops but also brought changes in floral morphology which is favorable for hybrid seed production [4, 5].

References

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