

Use of gametocide for emasculation in Soybean (*Glycine max* (L) Merr.).

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Abstract

Hybridization is a tedious operation in soybean. Gametocides have been used in a number of crops to induce male-sterility either for hybrid seed production or as a substitute for hand emasculation. However, there is no report of use of gametocide on Soybean. Ethyl 4'fluorooxanilate at the rate of 1000 ppm was used for inducing male –sterility. Preliminary study shows that the pollen sterility varied from 20.03% to 55.55% in the treated samples as compared to 1.37% to 2.63% in the control. The effectiveness of the gametocide can be improved by increasing the quantity of the gametocide used or by spraying at an appropriate stage. Even with 50% sterility it can be successfully used in combination with a dominant morphological marker for emasculation.

Introduction

Hybridization is a tedious operation in soybean due to cleistogamous flower, small floral parts and flower drop. Soybean has a small flower with diadelphous stamens surrounding stigma. Flowers are prepared for crossing just before the petals are first visible as the flower emerges from the bud. Hybridization is also affected by high temperature and low humidity under tropical and sub-tropical conditions. Thus there are two problems; one is of small flower size and other of drying of stigma under high temperature and low humidity conditions. Various methods have been suggested to overcome these problems. For small flower size use of optical microscope under artificial climate chamber (1) and in field conditions (2) or crossing without emasculation using a dominant marker (3) has been suggested. To overcome drying of stigma emasculation of flower in early morning (5.00 to 8.00am) and crossing on the same day (4), use of grease proof paper with isolator (5), pollen storage and crossing in the evening hours (6) and use of a small water wet cotton for covering the emasculated bud (7) have been suggested. These methods have been useful in

improving the success rate of cross-pod set from 16 to 34%. However, the number of buds, which can be emasculated, still remains very low. If, the number of buds emasculated can be increased, the number of crosses attempted will also increase. Increase in number of crosses will be a great boost to soybean improvement programme.

Materials and Methods

Ethyl 4'fluorooxanilate at the rate of 1000 ppm was sprayed in the early morning hours. The control was sprayed with distill water. Observations on pollen sterility were made. To study pollen sterility floral bunches were collected after one week and fixed in 1:3 acetic alcohol. Anthers from 3 to 4 buds were smeared together over a drop of potassium iodide (1%) solution and examined under a light microscope. Pollen grains that were of normal size and shape, well filled and fully stained were taken as fertile and those that were non-strained, partially strained, disfigured and shriveled as sterile.

Results and Discussion

Preliminary study shows that the pollen sterility varied from 20.03% to 55.55% in the treated samples as compared to 1.37% to 2.63% in the control (table 1). Thus there is significant difference in pollen sterility in the treated samples and the gametocide ethyl 4'fluorooxanilate is effective in inducing male sterility.

Gametocides have been used in a number of crops to induce male-sterility either for hybrid seed production or as a substitute for hand emasculation (8,9,10,11,12). However, there is no report of use of gametocide on Soybean. There are three major groups of chemicals, which have been used for the purpose, namely ethylene-releasing compounds, arsenic compounds and growth hormones (13).

Usefulness of Oxanilates has been well documented. Of the three derivatives ethyl 4'fluorooxanilate was found most effective in other crops (14). The dose of 1000 ppm was found to be most effective (15). The effectiveness of the gametocide can be improved by increasing the quantity of the gametocide used or by spraying at an appropriate stage. Even with 50% sterility it can be successfully used in combination

with a dominant morphological marker for emasculation. However a more detailed and in-depth study is required to standardize the quantity of gametocide to be used and the appropriate stage for application of gametocide.

Table 1. Pollen Sterility in six genotypes of soybean.

S.No.	Genotype	Pollen sterility (%)
1.	BJJF-8	20.0±0.53
	Control	1.73± 0.02
2.	PKV-25	55.55±0.67
	Control	2.63±0.03
3.	JS-90-41	32.41±0.42
	Control	1.37±0.02
4.	EC-391172	31.42±0.31
	Control	2.01±0.01
5.	Pusa-16	27.58±0.23
	Control	1.96±0.01
6.	Pusa 37	20.93±0.11
	Control	1.43±0.01

References

1. Gridnew A K and Kohegura A V .1988. Methods of increasing the efficacy of hybridization in soybean. *Selektsiya I Semenovodstvo*, Moscow, 3: 10-12.
2. Vollman J., Gruber H., gretzmacher R. and Ruckenbauer P. 1992. Note on efficiency of artificial hybridization in soybean. *Bodenkulture*, 43: 123-127.
3. Walker A K., Cianzio S R., Bravo J A and Fehr W R. 1979. Comparison of emasculation and non-emasculation for hybridization of soybean. *Crop Sci.*, 19: 285-286.
4. Kolot V N. 1981. Hybridization of soybean in south of the Ukrain. *Referativnyi Zhurnal*, 8.65.270.

5. Baraev K H A. 1992. Procedure increasing hybrid seed set in soybean. *Selektsiya I Semenovodstvo, Moskva*, 1: 30-31.
6. Li Weidong, Duan Gule and Xu J J. 1996. Effect of emasculating and pollinating time on rate of soybean crossing success. *Soybean Sci.*, 15: 326-366.
7. Agrawal A P., Ravikumar R L., Salimath P M and Patil S A. 2001. Improved method for increasing the efficacy of hybridization in Soybean (*Glycine max (L.) Merrill*). *Indian J. Genet.*, 61(1):76-77.
8. Fairey, D T and Stoskof N C.1975. Effects of granular ethephon on male sterility in wheat. *Crop-Sci.* 15: 1, 29-32.
9. Klimov-MN. 1971. Induction of male sterility in the sunflower by a chemical method. *Sb.-nauch.-issled.-rabot-po-maslichn.-kul'turam*. 1971, 8-10.
10. Kaul-CL.1971. Investigations into causes of sterility. III. Gametocide-induced male-sterile *Vicia faba L.* *Cytologia*.36: 2, 219-228.
11. Natrova-Z. 1973. Suitable methods for the artificial crossing of cereals with special regard to rye. *Genetika-a-Slechteni*. 9: 2, 127-134.
12. Anonymus.1978. Studies on male sterility of rice induced by "male gametocide 1". China, Kuangtung Cooperative Investigation Group for the Utilization of Heterosis in Crops, South China Agricultural College. *Acta-Botanica-Sinica*. 20: 4, 305-313.
13. J J Batch, K P Parry, C F Rowe, D K Lawrence and M J Brown.1980. Method of controlling pollen formation in monoecious and hemaphrodite plants using oxanilates and their derivatives. In: *Plant growth regulators and herbicides, Antagonists-Recent advances*. J C Johnson (ed.). Noyes Data corporation, New Jersey, pp 82-89.
14. Ali-AJ; Devakumar-C; Zaman-FU; Siddiq-EA. 1999. Gametocidal potency of ethyl 4' fluorooxanilate in rice. *Ind. J. Genet.*59: 3, 267-279.
15. Mathur-DS; Lal-SK. 1999. Chemical induction of male sterility in chickpea. *Ind. J. Genet.*59: 3, 379-380.

