‘Venere’ and ‘Alarico’, New Scarlet Runner Bean (*Phaseolus coccineus* L.) Cultivars with Determinate Growth Habit

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Additional index words. bush bean, pedigree breeding, vegetable breeding, interspecific cross

Runner bean cultivars grown in Italy are cross-pollinated climbing plants (2.5 to 3 m tall) that require hand-labor for staking and harvesting. They produce white and slightly reniform seeds (1.3 to 3.0 g) with flattened cotyledons. This kind of bean is called ‘Bianco di Spagna’ (Spanish White) in Italy. It is cultivated for the production of dry seeds or yellow pods containing seeds at the waxy stage. Both of these products can be used for processing or direct marketing.

The development of determinate (bush) *P. coccineus* germplasm suitable for mechanical harvesting is an objective of a breeding project at the Experimental Institute for Vegetable Crops, Montanaso Lombardo, Milano, Italy (Campion and Servetti, 1991). ‘Venere’ and ‘Alarico’ are the first cultivars with a determinate growth habit developed in this program. The former was registered as a cultivar (Feb. 1994) in the Italian National Register of Varieties, which is under the control of the Ministry of Agriculture; the latter will be registered in 1996 in the same registry. Indeterminate (runner) and determinate types are adapted to hillside and mountainous areas in northern Italy at 300 to 1000 m. Such growing sites have light winds and moderate temperatures during summer (July to August), which permit good pod set. The presence of *Hymenoptera*, in particular bumblebees (*Bombus* spp.), is necessary for self- and cross-pollination. Cross-pollination by these insects is 12.8% (Salamini and Uncini, 1971).

Origin

Breeding to transfer the determinate growth habit from *P. vulgaris* to *P. coccineus* started with interspecific crosses using five cultivars of *P. vulgaris*: dry bean ‘Borlotto di Vigevano’ and snap beans ‘Contender’, [Southeast Vegetable Breeding Laboratory, Charleston, S.C. (Mississippi, Alabama, and Florida Agriculture Expt. stations cooperated in this release)], ‘Topcrop’ (U.S. Dept. of Agriculture, Beltsville, Md.), ‘Wade’ (Southeast Vegetable

Breeding Laboratory), and ‘Corene’ (The Netherlands) (Fig. 1). These cultivars were used as female parents, and ‘Bianco di Spagna’, a large-seeded ecotype of *P. coccineus* cultivated on the hillside and mountainous areas of Alba, Cuneo Province, Italy, was used as the male parent because reciprocal crosses were difficult to accomplish. Three backcrosses with *P. coccineus* followed the initial interspecific cross. ‘Bianco di Spagna’ was used as the recurrent male parent in the first two backcrosses and as a female parent in the final backcross (BC₃) to change the cytoplasm to that of *P. coccineus* (Campion and Servetti, 1991). The F₃, BC₁F₃, and BC₂F₆ seeds sampled constituted the BC₁, BC₂, and BC₃ generations, respectively, and were selected on the basis of superior plant architecture and large seed size. Seed size was insufficient in the lines with *P. vulgaris* cytoplasm (1110 to 1670 seeds/kg, 600 to 900 g/1000 seeds), even after two backcrosses with *P. coccineus* used as the male parent. The change of cytoplasm obtained with the reciprocal backcross (BC₃), therefore, was important to increase seed size (Campion and Servetti, 1991). Progeny of each generation was obtained by open-pollination. ‘Venere’ and ‘Alarico’ were se-

lected as single open-pollinated plants in the BC₃F₆ generation, and the first seed bulk was obtained in ‘Venere’ from BC₃F₈ and in ‘Alarico’ from BC₃F₉ produced in isolation.

Description

Most phenotypic traits of ‘Venere’ and ‘Alarico’ are typical of *P. coccineus*, except determinate growth habit. They show hypogeal germination, long inflorescence, and fleshy pods. Raceme lengths range from 350 to 500 mm and pod lengths from 90 to 150 mm. Determinate plants show the bush growth habit and are 400 to 600 mm high. Petals are white in ‘Venere’ and red in ‘Alarico’. The seeds of ‘Venere’ are white, and those of ‘Alarico’ are black-mottled on a wine-pink background (Fig. 2). ‘Alarico’ shows red veins along its hypocotyls, stems, and petioles. Pods can be found in any position along the raceme of either cultivar, and each pod contains one to five seeds. The weights of 1000 seeds of ‘Venere’ and ‘Alarico’ are 1600 ± 354 g (≈ 625 seeds/kg), and 1650 ± 341 g (≈ 606 seeds/kg), respectively. Seeds of both cultivars are slightly more cylindrical than those of the original cultivars from which they were derived.

Determinate, like indeterminate plants, tend to produce regrowth with leaves and flowers after the first harvest when growing conditions are favorable (16 to 24°C and wet soil). For this reason, it is not possible to define a cultivar’s exact vegetative cycle. However, seed is produced between 120 to 130 days after emergence. Harvest at the waxy stage is performed when the pods have turned yellow and the seed is completely formed. The first pods ripen between 105 to 110 days after emergence. Seed set and maturation is optimal at $<28^\circ\text{C}$.

Yield data of the two cultivars were obtained in 1994 from testing at three locations [Parma and Montanaso Lombardo (Padana plain)], where they were compared with the commercial cultivar of *P. vulgaris* ‘Taylor’s

Fig. 1. Pedigrees of the determinate scarlet runner beans ‘Venere’ and ‘Alarico’ (*Phaseolus coccineus* L.).

Received for publication 30 Nov. 1994. Accepted for publication 18 June 1995. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Fig. 2. Seeds of (1) 'Venere' and (2) 'Alarico' (*Phaseolus coccineus* × *P. vulgaris* L.) compared with those of the runner bean (3) 'Bianco di Spagna' (*P. coccineus*) and (4) 'Taylor's Horticultural' (*P. vulgaris* L.).

Horticultural'. In addition, they were evaluated in the mountainous area of Alba, near the town of Cuneo at 800 m, where they were compared with the runner type 'Bianco di Spagna'. 'Venere' and 'Alarico' were spaced (within and between rows) at 15×100 cm, 'Taylor's Horticultural' at 5×50 cm, and the runner cultivar Bianco di Spagna at 50×170

cm. The dry seed yield of 'Venere', 'Alarico', and 'Taylor's Horticultural' was 57, 76, and 2253 kg·ha⁻¹, respectively, at Montanaso Lombardo and 103, 128, and 1445 kg·ha⁻¹, respectively, at Parma. At Alba, 'Venere', 'Alarico', and 'Bianco di Spagna' produced 1816, 1988, and 2642 kg·ha⁻¹, respectively.

The total hand-labor required for the culti-

vation of the runner-type 'Bianco di Spagna' is as follows: 15% for sowing and pesticide applications, 35% for staking, and 50% for harvesting. In comparison, the cultivation of 'Venere' and 'Alarico' offers important economic advantages: easier mechanized sowing, no staking required, pesticides easily applied, and harvesting partially mechanized. Staking is most important in terms of percentage of total hand-labor saved (35%), followed by harvesting (20%) and sowing (8%). Thus, the economic savings from cultivation of these new cultivars would mitigate the advantages (larger seed and higher yield) obtained from the cultivation of the runner-type 'Bianco di Spagna'.

Availability

Small samples of seeds for breeding purposes can be supplied by the Research Institute for Vegetable Crops, via Puallese 28, 20075 Montanaso L., Lodi, Italy.

Literature Cited

- Campion, B. and E. Servetti. 1991. Breeding in the runner bean (*Phaseolus coccineus* L.) for the development of dwarf lines. *J. Genet. & Breed.* 45:173-180.
- Salamini, F. and L. Uncini. 1971. Frequenze di esincrocio nel fagiolo di Spagna (*Phaseolus coccineus* L., *Phaseolus multiflorus*, Willd). Estratto dagli Annali dell'Istituto Sperimentale per l'Orticoltura vol. II:9-14.