The need for increased production of food and/or feed grains to keep pace with ever-increasing human population and preservation of natural resources is emphasized by the estimated addition of ≈ 75 million people per year until 2020 (International Food Policy Research Institute, 1999). The use of inorganic fertilizers, especially nitrogen, has created a problem for modern agriculture; on one hand, their use has been linked to environmental pollution, while on the other hand they have contributed to yield increases (Drinkwater et al., 1998). Underutilized legumes, such as tepary bean (Phaseolus acutifolius A. Gray), can serve as alternative sources of food and/or feed grains, maximize water use efficiency because of their high level of drought resistance (Thomas et al., 1983), reduce water pollution resulting from the use of inorganic nitrogen fertilizers, and diversify cropping systems.

Tepary bean, a native to northwestern Mexico and southwestern United States, received special honor for flavor and reliability of yields under rain-fed conditions at the 1912 International Dry Bean Congress. Yet its promise was never realized due to the development of irrigation, made possible by diverting rivers and pumping groundwater (Nabhan, 1983). However, tepary beans have not received much research interest even though 163 cultivated and 156 wild tepary bean accessions are stored in germplasm repositories throughout the world (Debouck, 1991). Miklas et al. (1994) suggested that there is a need to evaluate tepary beans for production potential in specific environments.

The cultivated tepary bean, similar to dry bean (Phaseolus vulgaris L.), is a short life-cycle annual desert legume indigenous to northwestern Mexico and the southwestern United States (Nabhan and Felger, 1978). Tepary beans are known to be resistant to many diseases, such as common bacterial blight caused by Xanthomonas campestris pv. phaseoli (Smith) Dye, and bean golden mosaic virus (Bigemivirinae: Geminiviridae), and have been used as donor parents to improve dry bean (Miklas and Santiago, 1996; Singh and Munoz, 1999). They are tolerant to heat and drought stress and produce nutritious, high-protein seed that is suitable for human consumption (Miklas et al., 1994; Thomas et al., 1983). In addition, they may have special value in Virginia and other southeastern states where wheat (Triticum aestivum L.) farmers traditionally have not had a crop to plant following wheat harvest in summer, and to harvest prior to planting of the next wheat crop during the fall. Some wheat farmers plant short-duration crop to fit winter wheat rotation. Harvest index was calculated as a ratio between seed weight and total plant material, were recorded. Data were recorded on seed yield (kg-ha\(^{-1}\)) and weight of 100 seeds (g) at =5% moisture. Harvest index was calculated as a ratio between seed weight and total plant weight and expressed as percentages.

All data were analyzed by procedures in version 6.11 of SAS (SAS, 1996). Duncan's multiple range test was used for mean separation with a significance level of 5%.

Results and Discussion

Significant variation existed for seed yield, seed weight, and harvest index among these genotypes (Table 2). Planting date and year effects were significant (P > 0.05) for seed yield and harvest index. The interactions between years, planting dates, and genotypes were nonsignificant (P > 0.05) for seed yield and harvest index. The years × planting dates,


Table 1. Seed color, seed yield, seed weight, and harvest index for eight tepary bean genotypes averaged over three planting dates and 2 years in Virginia.

| Genotype   | Seed color (kg·ha⁻¹) | Seed wt (g/100 seed) | Harvest index (%) |
|------------|----------------------|-----------------------|-------------------|
| Neb-T-4    | Black 1988 a         | 14.2 c                | 46.9 a-c          |
| Neb-T-5    | Tan 1928 ab          | 14.9 b                | 45.9 a-c          |
| Neb-T-11   | White 1920 t         | 13.8 a                | 41.6 a            |
| Neb-T-15   | Black 1862 a-c       | 14.9 b                | 47.1 a            |
| Neb-T-9    | White 1833 a-c       | 14.0 c                | 44.0 bc           |
| Neb-T-8    | Black 1719 a-c       | 12.6 d                | 43.2 c            |
| Neb-T-3    | Tan 1658 bc          | 18.8 a                | 38.1 d            |
| Neb-T-14   | Tan 1618 c           | 15.3 b                | 45.9 a-c          |

*Ratio between seed weight and total aboveground plant weight (including seed weight), expressed as percentage.

Table 2. Partial analysis of variance for seed yield, 100-seed weight, and harvest index for eight tepary bean genotypes evaluated at three planting dates in Virginia in 1997 and 1998.

| Source              | df | Seed yield (kg·ha⁻¹) | Seed wt (g/100 seed) | Harvest index (%) |
|---------------------|----|----------------------|----------------------|-------------------|
| Genotypes (G)       | 7  | 332445*              | 39.7**               | 0.015**           |
| Y × PD              | 2  | 577703               | 51.8*                | 0.002             |
| Y × G               | 7  | 265444               | 3.5**                | 0.001             |
| PD × G              | 14 | 138589               | 1.2*                 | 0.002             |
| Error               | 84 | 136422               | 0.6                  | 0.001             |

*Values followed by similar letters are not different (P > 0.05).

*Ratio between seed weight and total aboveground plant weight (including seed weight), expressed as percentage.

*Significant at P = 0.05 and 0.01, respectively. Mean squares due to years were tested against years × rep as error mean squares; mean squares due to PD and years × PD were tested against years × rep × PD as error mean squares.

Table 3. Mean seed yield, seed weight, and harvest index for three planting dates averaged over eight tepary bean genotypes and 2 years in Virginia.

| Planting date | Seed yield (kg·ha⁻¹) | Seed wt (g/100 seed) | Harvest index (%) |
|---------------|----------------------|----------------------|-------------------|
| Late May      | 2239 a               | 14.9 a               | 46.7 a            |
| Mid-June      | 1899 b               | 14.3 a               | 44.0 ab           |
| Mid-July      | 1310 c               | 15.3 a               | 42.8 b            |

*Ratio between seed weight and total aboveground plant weight (including seed weight), expressed as percentage.

*Values followed by similar letters are not different (P > 0.05).

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