Vegetable Soybean Development in Canada

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Introduction and Methods

Soybean, *Glycine max* (L.) Merr., an important crop around the world, is grown mainly for its meal, oil, and whole bean products (Wilcox, 1987). It is a nutritious crop, on a dry matter basis it contains 20% oil and 40% protein. Vegetable soybean (Edamame), harvested when the seeds are immature, has equal or even higher nutritional values (Weiss et al., 1942). It has been gathered and eaten for as long as man has cultivated soybeans and has become an import source of nutrition worldwide, especially in developing countries (Carter and Shanmugasundaram, 1993). Edamame is a relatively new crop in Canada, it has the potential as a high valued cash crop with increasing market demand for their well known nutraceutical values (Setchell, 1998).

Fehr et al. (1971) divided the life cycle of the soybean into 3 vegetative (V1-3) and 8 reproductive (R1-8) stages, from the completely unrolled leaf at the unifoliolate node (V1) to harvest maturity (R8). Timing for harvesting vegetable soybean is critical and often difficult to determine. It is recommended at R6 stage, when full size green beans are at one of the four uppermost nodes with a completely unrolled leaf (Fehr et al., 1971), is the best time to harvest (Konovsky et al., 1994). A maturity indexing system was adopted by using corn heat units (CHU) to determine the suitability of geographical regions for grain soybean production (Brown, 1975). The heat units requirement for vegetable soybeans is not as great as for grain soybeans since vegetable soybeans are harvested before seeds reach maturity (Weiss et al., 1942) which is suitable for the most part of Canada..

In the last few years, Canada has started a soybean breeding program specially for vegetable soybean and processing purpose due to the increasing demand. The purpose of this project was to select suitable varieties for vegetable soybean production in British Columbia and other regions of Canada based on their CHU during the growing season, agronomic responses, and yield.

Four varieties (Maple Glen, Apache, Karikachi, and Tohya) were tested in 1998 and 1999 at the Pacific Agri-Food Research Centre, Summerland, British Columbia. Maple Glen and Apache were developed at the Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario. Seeds of both Karikachi and Tohya were obtained from Japan (Tokita Seed Co. Ltd., Nakagawa, Omiya-shi, Saitama-Ken, Japan 330). Large beans from both Tohya and Karikachi have been especially selected for relatively early production. Rows of seeds were planted in sandy loam soil in mid- to late-May of each year when the soil temperature is 10 ^{o}C and above at the depth of 2.5 - 4 cm. There were 50 seeds per variety per row seeded, 10 cm apart, 2.5 cm deep, 50 cm between rows. Rhizobia inoculums (Hi Stick, supplied by First Line Seeds Ltd., Guelph, Ontario) was thoroughly mixed with seeds before seeding. Ten plants in the centre of each row were harvested and evaluated for plant height at the time of harvest, height of bottom pod, yield per plant, seed/pod index and bean fresh weight. Number of CHU required for each variety to reach 75% germination and harvest stage (R6) were recorded. A seed/pod index was calculated as follows: (4A + 3B + 2C + 1D)/(A + B + C +

D), where A, B, C, and D represent the number of pods in each plant with 4, 3, 2 and 1 beans within each pod.

Plant height was measured when beans were harvested. Apache was the tallest among varieties tested and vegetable soybean varieties Karikachi and Tohya were the shortest (Table 1). The height of bottom pod for Karikachi was higher than Tohya which is an advantage for mechanical harvest, since low bottom pods likely will be damaged by the harvester. Karikachi and Tohya had lower yields than Apache or Maple Glen. Tohya had significantly heavier fresh beans than any other variety tested.

Results

Variety selection for commercial production is important. Consumer preferences and higher market value for varieties with large beans and more than 2 beans per pod (seed/pod index > 2.0) are recommended. Grain soybean variety, Maple Glen, produced higher seed/pod index than other varieties (Table 1). However, the relatively smaller beans (38 - 45 g/100 beans) are not as attractive to consumers as the vegetable soybean varieties. Apache produced relatively high yields with an average of 38 - 48 g/100 beans. The disadvantage of the Maple Glen and Apache is their indeterminate growth habit which results in different sizes and maturity level of pods when harvested at the R6 stage. CHU required for seed emergence ranged from 145 for Apache to 204 for Karikachi and Tohya. The CHU requirements for plants to reach R6 stage were slightly higher for vegetable soybean varieties than for grain soybean variety. Karikachi and Tohya needed between 2200 to 2300 CHU and Maple Glen needed only around 2100 CHU to reach R6 stage. These CHU requirements should allow most of the regions in Canada to grow vegetable soybean as a new alternative crop. It would be ideal to have more than one variety for commercial production to prolong the harvest period and provide a longer period of vegetable soybeans for the fresh market.

Table 1. Plant height, yield, seed/pod index and weight of fresh bean in vegetable soybean variety trials

Variety	Height (cm)		Yield g/plant	Seed/pod index	Fresh bean wt. (g) x 100
	Bottom pod	Plant			
			1998		
Apache	12.3 b*	92.5 a	78.3 a	2.1 b	48.5 c
Maple Glen	8.8 c	79.0 b	73.0 a	2.4 a	45.3 c
Karikachi	15.0 a	50.4 c	51.3 b	1.9 b	53.9 b
Tohya	6.0 c	40.0 c	71.4 a	2.1 b	66.6 a
			1999		
Apache	11.6 b*	88.0 a	156.2 b	2.2 a	38.4 c
Maple Glen	8.0 c	76.0 b	178.4 a	2.2 a	37.7 c
Karikachi	14.7 a	39.6 c	169.0 c	1.8 c	52.7 b
Tohya	6.7 c	26.6 c	102.3 c	2.0 b	60.4 a

*Means in each column followed by the same letter are not significantly different (p=0.05) according to Duncan's New Multiple Range Test.

Summary

In conclusion, the possibility of growing vegetable soybeans in Canada with varieties from Asia has been demonstrated. Production can be further improved with better crop management such as fertility, soil moisture, storage conditions, better harvesting equipment to reduce labour costs, and development of varieties more suitable for Canadian conditions.

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