A new Soybean cultivar, "Fukuibuki", with high isoflavone content and superior agronomic characteristics for Japan

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Abstract

A new soybean (*Glycine max* (L.) Merr.) cultivar called "Fukuibuki", registered as "Soybean Norin 122", was developed in 2002 at the National Agricultural Research Center for Tohoku Region in Japan.

It is classified in group III in terms of days to maturity. Fukuibuki has a medium stem height with determinate growth. It is resistant to Soybean Cyst Nematode and Soybean Mosaic Virus (strains A,B,C,D). It shows good productivity in both upland and drained paddy field. It has good suitability for tofu processing and a higher isoflavone content, therefore it can be used for added-value soybean food products in Japan.

Media summary

A soybean cultivar Fukuibuki with high isoflavones content was developed for Tohoku region in Japan. It is proposed to be used for tofu and added-value products.

Kew words

High yield, Tofu processing suitability

Introduction

Isoflavones are a type of phytoestrogen, compounds that have weak estrogenic activity. It is said that isoflavones have some health-promoting benefits for humans, such as cancer and heart disease-preventive properties, and it would be one of the reasons for the longest longevity of Japanese in the world. Japanese eat many kinds of soybean foods, *e.g.* tofu, miso and fermented soybeans *etc.,* however it is claimed that the daily intake of isoflavones by the Japanese is less than the necessary quantity, especially in the younger generation (Yamori *et al.* 2001). We have been studying the genetic diversity and genetic analysis of isoflavone content in soybean seeds and found that it will be possible to increase it by breeding (Sakai *et al.* 2000). The cultivars for the southern parts of the Tohoku district in Japan, should have resistance to both Soybean Mosaic Virus (SMV) and Soybean Cyst Nematode (SCN, *Heterodera glycines* Ichinohe). Therefore we developed a soybean cultivar with high isoflavone content and resistance to both SMV and SCN for increasing the benefit to farmer's .

Methods

Fukuibuki traces to a single plant selection in the F_5 generation from the cross of "Tohoku 96" and "Dewamusum" in 1988, and selected for resistance to both SMV and SCN, with high lodging resistance.

Preliminary agronomic evaluations were conducted at eight sites in total in 1994 and 1995, and the performance tests for recommendable variety had been done at eighty sites in total from 1996 to 2001. SMV and SCN resistance were evaluated in NARCT and official test sites.

The apparent photosynthesis of young fully expanded leaflet of three cultivars grown at drained paddy field was measured with LI-6400 (LI-COR, Inc. Lincoln, NE, USA) at saturated light intensity. The yield trials of NARCT (Long.140?E, Lat. 39?N.) were done from 1999 to 2001 at upland and drained paddy field with three replicates by conventional cultivation method. The seed total isoflavones content was measured with HPLC. The performance test for recommendable variety in Fukushima Prefectural Agricultural Experiment Station (FPAES, 140?E, 37?N.) was held by standard method of the prefecture.

Results

Fukuibuki features purple flowers, gray pubescence, and broad leaflets and brown pods at maturity. The seeds of Fukuibuki are medium large (about 0.3g per seed), dull whitish yellow with yellow hila. The official tests for SMV and SCN resistance revealed that Fukuibuki has resistance to both SMV (strains A,B,C,D) and SCN(race 3).

The apparent photosynthetic rate of Fukuibuki tended to be higher than the other cultivars during seed filling period in 2000 and 2001(Figure 1). The seed yield of Fukuibuki at NARCT was higher than that of Suzuyutaka and Tachinagaha, which are the dominant cultivars in Southern parts of the Tohoku District (Table 1). The seed yield of Fukuibuki was also higher than Suzuyutaka and Tachinagaha in Fukushima Prefecture (Table 2).

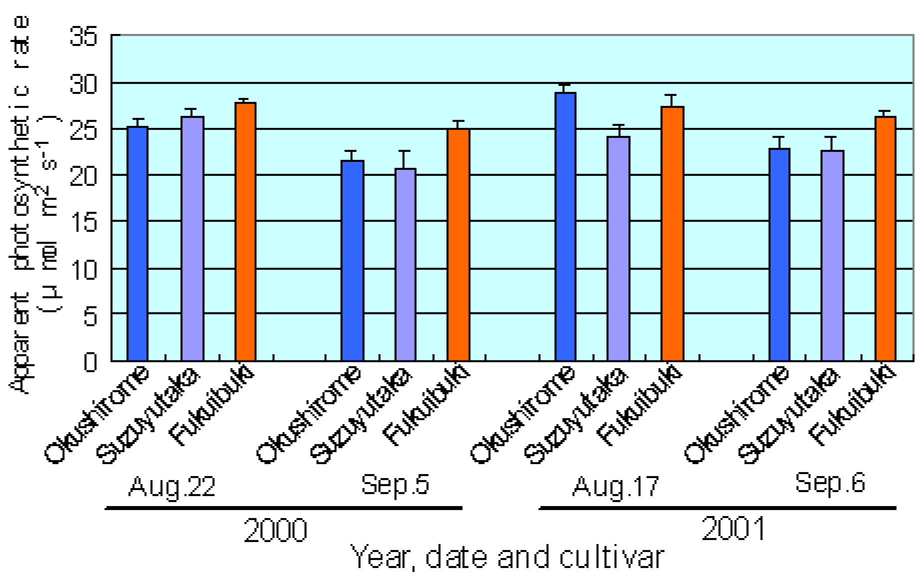

Figure 1. Cultivar difference in apparent photosynthetic rate during seed filling period in 2000 and 2001.

The vertical bars represent +SE of ninec plants.

Cultivar	Seed yield ($g\ m^{-1}$)		
	Upland field (Volcanic ash soil)	Drained paddy field (Gray Lowland soil)	Average
Fukuibuki	284.6	398.4	341.5 a
Enrei	244.6	401.7	323.2 ab
Suzuyutaka	262.3	365.9	314.1 bc
Tachinagaha	245.0	349.3	297.2 c

Table 1. Seed yields of four major soybecan cultivars for Southern Tohoku district at different soil types in yield trials of NARCT from 1999 to 2001.

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

Cultivar	Date of maturity	Stem length (cm)	Main stem node number	Seed yield ($g\ m^{-1}$)	100 seeds weight (g)
Fukuibuki	Oct. 15	61	14.7	330	30.5
Suzuyutaka	Oct. 11	70	16.4	279	27.0
Tachinagaha	Oct. 16	67	15.5	244	35.9

Table 2. Agronomic characteristics in performance test at FPAES from 1996 to 2001.

The seed total isoflavones content of Fukuibuki is higher in both soil types in NARCT (Table 3), and 50 to 90% higher in three sites of FPAES, than the other cultivars (Table 4).

Cultivar	Total isoflavones content (mg/100gDW)		
	Upland field (Volcanic ash soil)	Drained paddy field (Gray Lowland soil)	Average
Fukuibuki	376.4	464.9	420.7 a
Suzuyutaka	321.2	319.9	320.6 b
Tachinagaha	313.0	303.8	308.4 b
Enrei	257.1	295.5	276.3 b

Table 3. Seed total isoflavones content of four cultivars at different soil types in yield trials of NARCT.

The total isoflavones content (daidzin, malonyl-daizin, genistin, malonyl-genistin, daizein, genistein) of the soybean seeds cultivated in 1999 to 2001 were measured using HPLC.

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

Cultivar	Total isoflavones content (mg/100gDW)			
	Fukushima Prefectural Agricultural Experiment Station(FPAES)	FPAES, Aizu Branch	FPAES, Souma Branch	Average
Fukuibuki	400.5	453.5	429.5	427.8 a
Suzuyutaka	264.5	235.0	259.5	253.0 b
Tachinagaha	225.0	239.0	248.5	237.5 b

Table 4. Seed total isoflavones content of three cultivars grown at three sites in Fukushima Prefecture in 2000 and 2001.

The measurement of isoflavones content and legend are the same as in Table 3.

Fukuibuki is suitable to cultivate in Southern parts of the Tohoku District according to the maturity group and SMV resistance (Figure 2).

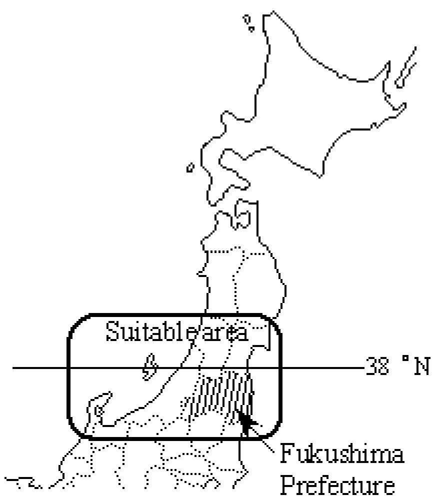

Figure 2. The suitable cultivation area for Fukuibuki in Japan.

The Fukushima Technology Centre had been studying the food processing suitability of Fukuibuki. It has been revealed that the tofu produced from Fukuibuki shows higher isoflavones content, breaking stress and sensory evaluation compared to other cultivars(Endo *et al.* 2003a, Endo *et al.* 2003b). Therefore some companies are planning to use Fukuibuki for making tofu and added-value food products (Figure 3).

Figure 3. Some trial desserts made from Fukuibuki soymilk for health-promoting benefits (courtesy of Fukushima Technology Centre)

Conclusion

Fukuibuki would show good productivity in southern parts of the Tohoku district and in the Hokuriku district. With those superior characteristics, Fukuibuki was selected as a recommended cultivar in Fukushima Prefecture in 2002 and will be used for producing added-value food products.

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