‘Taichung No. 5’: A Short Plant Height with High Grain Yield Job’s Tears Cultivar

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Coix lacryma-jobi L., also named as job’s tears, is widely cultivated and applied as food and herbal medicine, especially in Asia (Aradilla, 2018; Arora, 1977). Low genetic diversity at the species and accession levels but a strong genetic variation among all accessions tested by intersimple sequence repeat markers was shown in a previous study (Xi et al., 2016). The authors also reported that the proportion of triglyceride in the accessions test could be a useful indicator for quality control. In addition, job’s tears cultivar Thai Black Loei, which has antiproliferative activity and apoptosis, has been shown to be a potential medicine to treat cancer (Manosroi et al., 2016).

In Taiwan, the ecological traits of job’s tears are an area of focus in breeding programs, for example, greater grain yield, larger grains, stronger lodging resistance, effective pest and disease resistance, and easier for mechanical harvest (Tseng and Chen, 2007; Tseng et al., 2009; Tseng and Kao, 1995). ‘Taichung No. 3’, an elite job’s tear variety, belongs to *Coix lacryma-jobi* var. *ma-yuen*, shows good characteristics, including stronger stalk to resistance lodging and greater grain yield (3500 kg/ha), and is commonly grow as a minor cereal crop and applied as healthy food (Bhavna et al., 2017; Kuo et al., 2012; Tseng et al., 2009). However, the plant height of ‘Taichung No. 3’ is 2 m taller than expected, which is an obstacle to harvest for farmers. Thus, the development of a shorter variety suitable for mechanical harvest with greater

grain yield is the main project of job’s tears breeding in Taiwan.

The Taichung Agricultural Research and Extension Station (TDARES) has announced

the release of the ‘Taichung No. 5’ job’s tears (*Coix lacryma-jobi* L.), a cultivar with greater grain yield and shorter plant height that is suitable for mechanical harvesting. This cultivar was developed using a series of crossing, selection, and evaluation using field performances as discussed in the sections to follow.

Origin

All breeding, crossings, selections, and performance studies have been conducted in field conditions by the pedigree method in TDARES (long. 24 °08’N, lat. 120 °32’E) since 2009. ‘Taichung No. 3’, which showed excellent traits such as high average grain yield (3000–4000 kg/ha) and resistance to lodging and leaf blight, was used as the female parent. ‘Auyu No. 3’ was used as the male parent, with traits of short fertility days, dwarfing, high tillering, and greater 1000-grain weight (Tseng et al., 2009). Thirty combinations were obtained after crossing between ‘Taichung No. 3’ and ‘Auyu No. 3’ in 2009, and their offspring ($F_1 \approx F_6$) were selected by pedigree method from 2009 to 2012. Three elite lines were selected from F_7 based on shorter plant height and

Table 1. The breeding procedures of job’s tears ‘Taichung No. 5’ in TDARES.

Program	Generation/line number	Season/yr
Crossing (Taichung No. 3 × Auyu No. 3)	F_0	Fall 2009
Selection (pedigree method)	F_1 (30 lines), F_2 (26 lines), F_3 (24 lines), F_4 (20 lines), F_5 (12 lines), F_6 (8 lines)	Spring and Fall 2009≈2012
Preliminary yield test	F_7 (3 new lines and C. K.)	Spring and Fall 2013≈2014
Advanced yield test	3 new lines and C. K.	Spring and Fall 2015
Regional yield test	3 new lines and C. K.	Spring and Fall 2016
Resistance test of disease and pest	Taichung No. 5	Spring 2017

TDARES = Taichung Agricultural Research and Extension Station.

Fig. 1. The appearance and performance in the field of job’s tears ‘Taichung No. 5’.

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Fig. 2. The grain shape and the color of job's tears 'Taichung No. 5' and C. K. 'Taichung No. 3'.

Table 2. The characteristics of 'Taichung No. 5' and 'Taichung No. 3' (C. K.) in 2017.

Variety	Taichung No. 5	Taichung No. 3 (C. K.)
Plant growth habit	Semi-upright	Semi-upright
Plant height (cm)*	178.3 ± 1.9	193.1 ± 1.5
Tillering (no.)	8 ± 0.4	8.7 ± 0.6
Growth duration (day)**	129 ± 0.4	132 ± 0.7
Stem color	Green	Green
Leaf color	Green	Green
Spikelet visible (day)**	63 ± 0.7	67 ± 0.4
Stigma color	White	White
Grain weight (g/1000 grain)	90.8 ± 0.5	84.9 ± 0.2
Grain ratio (length/width)	Medium	Medium
Grain color	Light brown	Dark brown
Grain yield (kg/ha)	3624 ± 269	2898 ± 396

*, **Significantly different at $P < 0.05$ or 0.01 , respectively.

Table 3. The resistant tests of leaf blight, borer, and stem maggot performed in 'Taichung No. 5'.

Resistance to disease and pest	Taichung No. 5	Taichung No. 3 (C. K.)
Leaf blight	MR	MR
Borer	MS	MS
Stem maggot	MR	MS

MR = medium resistance (5.1% to 25%); MS = medium sense (25.1% to 50%).

greater grain yield. The preliminary yield tests were conducted in Spring and Fall 2013, Spring 2014 (three times of preliminary yield tests), and the advanced yield tests were finished in Spring and Fall 2015 (two times of advanced yield tests). In addition, the region trials for yield were performed in 2016. Afterward, the best elite line 'TCB20', which showed shorter plant height and high grain yield, was obtained based on the overall

performance. The phenotypic evaluation of TCB20, including the resistance to leaf blight (*Exserohilum turcicum*) and pest (Asian corn borer, *Ostrinia furnacalis* and stem maggot, *Atherigona soccata*) and distinctness, uniformity, and stability was conducted in 2017. Finally, the cultivar TCB20 was officially named 'Taichung No. 5' in Dec. 2017 by TDARES (Table 1).

Description

'Taichung No. 5' shows well, stable, and uniform performance in the field (Fig. 1), the grain shape of 'Taichung No. 5' is oval, and the color is light brown (Fig. 2). In addition, it has desirable traits, for instance, less growing time, short plant height, greater 1000-grain weight and grain yield (129–132 d, 178.3–193.1 cm, 90.8–84.9 g, and 3624–2898 kg/ha, respectively) than its control, 'Taichung No. 3' (Table 2). In

addition, 'Taichung No. 5' shows greater stem maggot resistance ability than 'Taichung No. 3', as shown in Table 3.

The new variety 'Taichung No. 5' has better characteristics than the current popular cultivar Taichung No. 3, most importantly, shorter plant height that is ready for mechanical harvest. Because of these improved and beneficial traits, we expect that this new variety 'Taichung No. 5' could replace 'Taichung No. 3' to be grown in the largest cultivation area in Taiwan.

Availability

A Taiwan Plant Breeder's Right of 'Taichung No. 5' has been granted by the Council of Agriculture, Executive Yuan, Taiwan (ROC) in 2017. A limited quantity of seed may be available for research purposes only by sending a request to the first author (liaoyl@tdais.gov.tw).

Literature Cited

- Aradilla, A.R. 2018. Phenology, growth and yield performance of adlay (*Coix lacryma-jobi* L.) grown in adverse climatic conditions. *Intl. J. Res. Rev.* 3:16–24.
- Arora, R.K. 1977. Job's-tears (*Coix lacryma-jobi*) a minor food and fodder crop of northeastern India. *Econ. Bot.* 31:358–366.
- Bhavna, P., P. Gopi, S. Samir, and P. Shradha. 2017. A review: *Coix lacryma-jobi* L. *Res. J. Pharmacognosy Phytochemistry* 9:248–252.
- Kuo, C.C., H.H. Chen, and W. Chiang. 2012. Adlay (yì yì; "soft-shelled job's tears"; the seeds of *Coix lacryma-jobi* L. var. *ma-yuen* Stapf) is a potential cancer chemopreventive agent toward multistage carcinogenesis processes. *J. Tradit. Complement. Med.* 2:267–275.
- Manosroi, A., M. Sainakham, C. Chankhampan, W. Manosroi, and J. Manosroi. 2016. In vitro anti-cancer activities of Job's tears (*Coix lacryma-jobi* Linn.) extracts on human colon adenocarcinoma. *Saudi J. Biol. Sci.* 23:248–256.
- Tseng, S.H. and T.C. Kao. 1995. The development of a new job's-tears cultivar Taichung No. 1. *Bull. Taichung District Agr. Res. Extension Station.* 47:11–22.
- Tseng, S.H. and Y.H. Chen. 2007. The breeding of a new job's-tears (*Coix lacryma-jobi* L.) cultivar Taichung No. 2. *Bull. Taichung District Agr. Res. Extension Station.* 97:1–11.
- Tseng, S.H., Y.H. Chen, and Y.L. Liao. 2009. The breeding of a new job's-tears (*Coix lacryma-jobi* L.) cultivar Taichung No. 3. *Bull. Taichung District Agr. Res. and Extension Station.* 102:59–69.
- Xi, X.X., Y.G. Zhu, Y.P. Tong, X.L. Yang, N.N. Tang, S.M. Ma, S. Li, and Z. Cheng. 2016. Assessment of the genetic diversity of different Job's tears (*Coix lacryma-jobi* L.) Accessions and the active composition and anticancer effect of its seed oil. *PLoS One* 11(4): e0153269.