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# Performance of Jobs Tears Lines (*Coix lacryma-jobi*) under Food Hill Condition of Nagaland

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**Abstract** An exploration and collection of jobstear germplasm was conducted in different district of Nagaland and a total of 10 accessions were collected, evaluated and conserved for documentation. The samples were in the form of jobster seeds with varying color and size. Keeping these in view, a field experiment was carried out during the pre- *kharif* season of 2015 to assess the best suitable high yielding line of jobstear to encourage and arouse the farmer's interest in its commercial cultivation under the food hill condition of Nagaland. Experiment was laid out in completely randomized block design and replicated thrice. A total of 10 jobstear germplasm viz. JBN-1, JBN-2, JBN-3, JBN-4, JBN-5, JBN-6, JBN-7, JBN-8, JBN-9 and JBN-10 were collected from the farmers' field across the different district viz. Jalukie, Kohima, Wokha, Zunheboto and Longleng of Nagaland was evaluated over here in terms of higher production potential under the rainfed condition. Results revealed that significant variations were observed in growth and yield attributes of jobstear lines. Among the tested lines of jobstear, JBN-10 line recorded the significantly higher yield attributes which led to higher grain yield as compared to other lines.

**Keywords** Job's tear, Germplasm, Exploration, Collection, Seed yield.

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## Introduction

The North East region has its own unique combination of living species, habitats and ecosystems which together make up its diversity rich resource. While speaking strictly about the plant diversity, two regions of the country are termed as hot spots i.e. Western Ghat and North Eastern Hill Region, in which Nagaland is one of the hot spot for biodiversity. Job'srear is the grain of a tropical Asian grass (*Coix lacryma-jobi*) originated from South-East Asia. Job's Tears is also known as *Adlay* (Filipion), *Jagradi* in

**Table 1.** Details of jobstear germplasm collected.

| Jobstear line | Local name | Village | District | Farmer's name | Altitude | Latitude | Longitude |
|---|---|---|---|---|---|---|---|
| JBN-1 | Kejanglwa local-1 | Kejanglwa | Peren | Gongrai | 735 m asl | 25°35 N | 93°41 E |
| JBN-2 | Kejanglwa local-2 | Kejanglwa | Peren | Gongrai | 735 m asl | 25°35 N | 93°41 E |
| JBN-3 | Phesama local | Phesama | Kohima | Zevilhuono | 1600 m asl | 25°37 N | 94°07 E |
| JBN-4 | Longsa local | Longsa | Wokha | Loth Ezung | 1470 m asl | 26°03 N | 94°15 E |
| JBN-5 | Koio local | Koio | Wokha | Ramongo | 1255 m asl | 26°07 N | 94°18E |
| JBN-6 | Yanthamo local | Yanthamo | Wokha | Yanamo Odyuo | 1418 m asl | 26°04 N | 94°17 E |
| JBN-7 | Yikhum local-1 | Yikhum | Wokha | Lochoni | 1246 m asl | 26°07 N | 94°14 E |
| JBN-8 | Yikhum local-2 | Yikhum | Wokha | Lochoni | 1246 m asl | 26°07 N | 94°14 E |
| JBN-9 | Longsachung local | Longsachung | Wokha | Zuchobeni | 1703 m asl | 26°03 N | 94°15 E |
| JBN-10 | Wokha local-1 | Wokha village | Wokha | Libeni Tungoe | 1250 m asl | 25°35 n | 93°41 e |

Sanskrit, *Sankru* in Hindi, *Gurgur* in Bengali, *Megaru* in Garo, *Sohriew* in *Khasi* and *Kunch* in Tripuri [1]. These grains have a number of uses from foods to ornaments and cultivated for thousand of years. Many Asian markets sell them in grain sections for cooking. Beaders and crafts people also use grains and they may be found at beading and craft stotes. Plants are also cultivated as ornamentals, incidentally and Western gardeners may not be aware that large grains on these grasses are perfectly edible. *Coix* grains are used as substitute for rice and roasted, husked and eaten whole or parched like maize or boiled with water as rice. A 100 g edible portion of the husked grain of job's tear contains: water 10.1–15 g, protein 9.1–23 g, fat 0.5–6.1 g, carbohydrates 58.3–77.2 g, fiber 0.3–8.4 g and ash 0.7–2.6 g [2]. Despite its minor crop status, job's tear is a nutritious grain, containing more fat and protein than rice and wheat [3]. *Coix* grain used as fodder has greater protein content, making its more advantages than corn. Food scientists have found that job's tear is a rich source of photochemical, having actions of anti-inflammatory, as well as a detoxifying agent. Job's tear is native to SE Asia and distributed throughout the tropical and subtropical parts of the world for its fodder and medicinal values. It has a wide range of adaptability and can be grown even under considerable moisture stress condition and impoverisshed soil. Its cultivation is reported in Philippines, India, China, Siam, Myanmar and Sri Lanka. In India, this plant is found in warm slope of hills up to an elevation of 1600 m particularly in North Eastern states [4]. It has a wide adaptability ranging from cool temperate moist to wet through triopical very dry to wet forest life zones, Job's tear is reported to tolerate annual precipitation of 6.1–42.9 mm, annual temperature of 9.6–27.8°C and pH of 4.5–8.4. With respect to area, production and productivity in Nagaland, it is cultivated over an area of 1,110 ha produced 1,110 ton with a productivity of 1000 kg/ha. The diversity of several important crops including jobstear spread across the world is threatened by rapid urbanization and habitat erosion as well as unpredictable and extreme climatic event including increasing frequency of drought and heat. The concerted and intensive effort are required to identify the climate-change-resilient jobstear lines, while accelerating yield without which outcome well be hunger and food insecurity for poor farmers of hilly region. The present investigation was carried with the objective to identify the best performing, high yielding Job's Tear lines under foot hill condition of Nagaland.

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## Materials and Methods

A systematic survey had been conducted duriong the 20142015 to collect the local jobstear germplasm from different district of Nagaland. A team of expect comprising of scientist, technical officers and SRF went for the exploration programme. The team discussed with local agricultural officers and KVKs and identified important jobstear growing regions in the

**Table 2.** Growth performance of Job's tears line under rainfed condition (mean data on one year). *DFFL Days to 50% flowering.

| Jobs-tear line | Plant height (cm) | Tillers/ plant (No.) | Green leaves/ plant (No.) | Inter-nodes/ plant (No.) | Dry matter plant (g) | DFF* (No.) | Days to maturity (No.) |
|---|---|---|---|---|---|---|---|
| JBN-1 | 261.11 | 7.33 | 66.67 | 16.41 | 75.10 | 105 | 163 |
| JBN-2 | 220.29 | 6.00 | 66.00 | 15.02 | 80.52 | 115 | 163 |
| JBN-3 | 161.01 | 5.00 | 48.50 | 13.10 | 70.34 | 111 | 165 |
| JBN-4 | 167.10 | 4.00 | 48.00 | 12.11 | 61.13 | 110 | 161 |
| JBN-5 | 178.91 | 3.50 | 40.33 | 13.39 | 60.10 | 110 | 151 |
| JBN-6 | 153.32 | 4.17 | 32.83 | 12.42 | 30.29 | 115 | 161 |
| JBN-7 | 183.41 | 3.83 | 40.17 | 14.53 | 40.00 | 106 | 151 |
| JBN-8 | 195.09 | 2.67 | 34.83 | 10.19 | 43.34 | 103 | 151 |
| JBN-9 | 233.03 | 5.00 | 71.67 | 12.20 | 73.63 | 105 | 149 |
| JBN-10 | 251.12 | 4.83 | 58.67 | 13.23 | 84.10 | 92 | 149 |
| SEm± | 5.38 | 0.11 | 1.32 | 0.34 | 1.66 | 0.84 | 0.72 |
| LSD (*p*= 0.05) | 15.98 | 0.34 | 3.92 | 1.01 | 4.94 | 2.49 | 2.15 |

states. The ream surveyed door to door and *jhum* fields for collecting the local jobstear germplasm. The details of germplasm collected from different places are mantioned below in Table 1. The field experiment was carried out at Agricultural Research Farm of ICAR Research Complex for North Eastern Hilly Region, Nagaland Center, Jharnapani, Medziphema during the pre-*kharif* season of 2015. The experimental site was located at 25°45´ N latitude, 93°53´ E longitude with mean altitude of 295 m above the mean sea level. Experiment was laid out in completely randomized block design with three replications consisting of 10 lines of job's tear viz. JBN-1, JBN-2, JBN-3, JBN-4, JBN-5, JBN-6, JBN-7, JBN-8, JBN-9 and JBN-10 (Table 1). The experimental soil was sandy loam with pH 5.3, high in organic carbon (0.78%), low in available N (175.4 kg/ha) and $K_2O$ (138.5 kg/ha) and moderate in available $P_2O_5$ (18.0 kg/ha) as well as available sulfur (15.8 kg/ha). The whole experimental field was divided into 3 equal blocks and each block was again divided into 10 equal plots. The lines were randomly allotted to plot size of 5.0 m × 3.0 m size maintaining a spacing of 0.5 cm between the plots. The seeds were sown @ 15 kg/ha in lines maintaining a spacing of 45 cm × 15 cm. The recommended dose of fertilizers (100% RRDF) viz. 40 kg/ha N, 20 kg/ha $P_2O_5$, 20 kg/ha $K_2O$ and 20 kg/ha S were applied through urea (46% N), di-ammonium phosphate (18% N and 46% $P_2O_5$) and nuriate of potash (60% $K_2O$), and elemental sulfate (90% S), respectively. Sulfur was applied as per treatment two weeks before the sowing. Half of the entire quantity of N and full quantity of P and K were applied as hasal according to the treatments. The remaining dose of nitrogen was top dressed after one month of sowing. Weeding was done manually using hoe at 20 and 35 days after sowing. The observations were recorded on growth attributes viz. plant height, tillers/plant, green leaves/plant, internodes/plant, yield attributes viz. panicle length, panicle/plant, grains/panicle and yields at harvest stage along with phonological characters viz. days to 50% flowering and days to maturity. Weather data on rainfall and temperature during crop growth period were collected and depected in Figure 1.

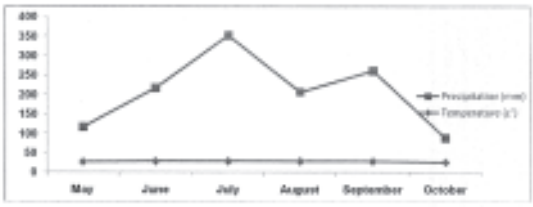


**Fig. 1.** Meteorological observation during the period of experimentation.

Statistical analysis

The experimental data pertaining to each parameters of study were subjected to statistical analysis by using the technique of analysis of variance and their significance was tested by *F* test [5]. Standard error of means (SEm±) and least significant difference (LSD) at 5% probability (*p*=0.05) were worked out for each parameter studied to evaluate the differences between treatment means.

## Results and Discussion

Effect of weather

The weather conditions prevailing during the crop season was found to be more or less conductive (Fig.

**Table 3.** Yield attributes and yield of Job's tear lines grown under upland condition (mean data on one year).

| Lines | Panicle length (cm) | Panicles/ plant (No.) | Grains/ panicle (No.) | Seed yield plant (g) | 1000-Seed weight (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| JBN-1 | 31.15 | 3.75 | 56.50 | 43.86 | 6.75 | 622.12 |
| JBN-2 | 28.29 | 3.75 | 85.00 | 25.81 | 8.04 | 366.09 |
| JBN-3 | 23.30 | 4.00 | 24.15 | 18.80 | 13.18 | 266.66 |
| JBN-4 | 23.10 | 2.75 | 36.34 | 17.00 | 10.45 | 241.13 |
| JBN-5 | 33.21 | 3.00 | 62.67 | 25.14 | 9.45 | 356.59 |
| JBN-6 | 21.19 | 3.00 | 30.10 | 14.80 | 7.39 | 209.92 |
| JBN-7 | 39.05 | 3.75 | 94.00 | 28.85 | 5.07 | 409.21 |
| JBN-8 | 41.34 | 3.50 | 88.05 | 14.08 | 5.81 | 199.71 |
| JBN-9 | 37.10 | 4.00 | 42.30 | 62.38 | 12.03 | 884.82 |
| JBN-10 | 34.00 | 4.25 | 65.29 | 62.58 | 13.01 | 887.65 |
| SEm± | 0.91 | 0.09 | 1.82 | 0.88 | 0.25 | 12.50 |
| LSD ($p$=0.05) | 2.70 | 0.27 | 5.41 | 2.62 | 0.75 | 37.13 |

1). The results of the present investigation in general indicated that temperature was normal but amount of rainfall varied appreciably from normal during the crop growth period. It is a well known fact that each crop species has a definite range of temperature for different growth stages. Beyond the upper and lowest threshold of temperature, the metabolic activity proceeding grmination is reduced.

Growth attributes

Table 2 shows the growth attributes of jobstear lines had significant differences. Among the tested jobstear lines, taller plants (261.1 cm) were recorded with JBN-1 line, which was statistically at par with JBN-10, while JBN-6 recorded the shortest plants (153.32 cm) which was at par with JBN-3 and JBN-4. With regards to the number of tillers, the maximum number of tillers/plant was recorded in JBN-1 (7.33) and the lowest in JBN-8 (2.67). The highest number of active leaves/plant was recorded ib JBN-9 line (71.67) and lowest was recorded in JBN-6 (32.83) which was statistically at par with JBN-8. The number of internodes/plant was found to be maximum with JBN-1 (16.41) line and the minimum values associated with JBN-8 (10.19). In case of dry weight production/plant, JBN-10 line recorded the highest dry matter production (84.1 g) among the rested line, which was statistically similar to JBN-2. The lowest dry matter production was associated with JBN-6 (30.29 g). Significant variations among the jobstear genotypes in growth components have also been reported by various researchers [6, 7].

Crop ontogeny

Among the tested line of jobstear, JBN-2 and JBN-6 line took the maximum number of days to 50% flowering (115 days) and JBN-10 line took lowest number of days to 50% flowering (92 days). However, JBN-3 line took the maximum days to maturity (165 days), which was statistically similar to JBN-2 and JBN-3, while JBN-9 and JBN-10 took the minimum days to maturity (149 days). In general all the Job's Tear lines attained maturity between 149 to 165 DAS.

Yield attributes

Significant differences were observed with respect to yield attributes among the different lines of jobstear (Table 3). With regard to panicle length, JBN-8 recorded the maximum length (41.34 cm), which was statistically similar to JBN-7, while JBN-6 recorded the minimum length (21.19 cm), which was statistically similar to JBN-3 and JBN-4. The highest number of panicles/plant (4.25) was found with JBN-10 line, which was statistically similar with JBN-3 and JBN-9, however the minimum number of panicles/plant was found in JBN-4 lene (2.75), which was statistically similar to JBN-5 and JBN-6. The highest grains/panicle (94) was recorded in JBN-7 line and the lowest values were associated with JBN-3 (24.1). Significant variations among the jobstear genotypes in yield attributes have also been reported by various researchers [6, 7].

Grain yield

Grain yield as influenced markedly with respect to different jobstear line (Table 3). With regards to grain yield/plant, JBN-8 line recorded the lowest grain yield/plant (14.08 g), which was statistically at par with JBN-6 line leading to the lowest yield/ha (199.71 kg). Similarly, JBN-10 recorded the highest yield/plant (62.58) leading to the highest grain yield/ha (887.65 kg), which was statistically similar to JBN-9. Significant variations among the Job's tear genotypes in yield have also been reported by various researchers [3].

Possible impact

Job's tear may opt a place in uncultivated and marginal lands. There appears to be a tremendous potential for cultivating *coix* in hills ecosystem to sustain the tribal livelihood. The major bottlenecks of production and processing technology need to be resolved by taking research on priority areas viz. yield enhancement by increasing harvest index, synchronous maturity, lodging resistant. A population improvement programme for locally adapted varieties as well as programme for development of composites in *coix* may be undertaken by research center located in the hills. Besides promoting *coix* cultivation in the upland of hills, special efforts should be made to introduce *coix* cultivation to uncultivated marginal and degraded lands in hills. This will not only generate income for poor farmers but also improve the structure of these lands to sustain agriculture for future generations. A concerted effort are thus, needed by research institutions, farmers in making improvement of such valuable crop.

## Conclusion

From this study, it can be concluded that there is enough scope for cultivation of jobstear in upland hill ecosystem condition. Therefore, the tested lines of jobster JBN-10, which showedoutstanding performances in terms of production potential is, therefore recommended for commercial cultivation under food hill condition of Nagaland.

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