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Research Note

Profitability and production cost of hybrid pigeonpea seed

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Abstract:
Hybrid pigeonpea technology, based on cytoplasmic nuclear male-sterility and natural out-crossing, was developed at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the first commercial hybrid 'ICPH 2671' performed well in farmers' fields with 30-35% yield advantage. The commercial viability of this hybrid, however, depends on the availability of seeds at an affordable cost so that even a small pigeonpea farmer could reap the benefits of this technology. So far no information is available on this aspect hence, the present investigation was undertaken at Agriculture College Research Farm, Indore (M.P.). In this large-scale experiment, one kilogram of hybrid (A x R) seed was produced at the cost of Rs 18.85. Further, the estimated profit from growing one hectare of seed production plot of this hybrid was Rs. 70,005. It was concluded that the seed production technology is easy and it can be adopted by seed producers; however, the presence of pollinating insects in the production area is essential.

Key words: Pigeonpea, hybrid, seed production cost, profitability

Pulses, the major sources of food protein in developing world, are generally grown under low input and risk-prone marginal environments of rainfed agriculture. In spite of their high importance in rainfed agriculture and health management, these crops receive less input and generally are relegated to poor soils with a little or no care and this results in low and unstable yields. Among the pulses, pigeonpea or red gram (*Cajanus cajan* (L.) Millsp.) occupies an important place in India with 3.7 m ha area and 2.7 m tons of production. Pigeonpea is credited to be the most suitable crop for subsistence agriculture because it is drought tolerant, needs minimum inputs, and can produce reasonable quantities of food even under unfavorable production conditions.

Research efforts towards genetic enhancement of pigeonpea are continuing since last 60 years but its productivity has remained low and unchanged at around 700 kg/ha. To overcome this bottleneck ICRISAT developed a hybrid breeding technology (Saxena *et al.* 1992) that is considered a major breakthrough in the history of breeding food legumes. The pigeonpea hybrid technology is powered by an efficient A_4 cytoplasmic nuclear male-sterility (CGMS) system (Saxena *et al.* 2005) and insect-aided natural out-crossing (Saxena *et al.* 1990). The hybrid technology holds promise of breaking the productivity barrier (Saxena and Nadarajan, 2010) in pigeonpea.

Gujarat Agricultural University released the first CGMS-based pigeonpea hybrid GTH 1 (GT 288Ax GTR11) during 2004. After 35 years of intensive research ICRISAT developed another CGMS-based commercial pigeonpea hybrid which was designated as 'ICPH 2671'. This hybrid has performed well in the states of Madhya Pradesh, Maharashtra, Karnataka, and Jharkhand (KB Saxena, personal communication). The success of this invention however will depend on the production cost of hybrid seed so that it could be made available to small holder farmers at affordable cost. Therefore, to estimate the seed production cost of a popular medium duration pigeonpea hybrid 'ICPH 2671', an experiment was conducted in 2007 rainy season.

A well drained field measuring 1.0 ha was selected in isolation at Agriculture College Research Farm, Indore (M.P.). The parental lines of the hybrid were sown in a ratio of 4 female ('ICPA 2043'): 2 male ('ICPR 2671') rows on ridges under rainfed conditions. FYM was applied before sowing. In order to ensure the extended supply of pollen grains for pollination, four lines of the restorer 'ICPR 2671' was also sown on the periphery of the field. A basal fertilizer doze of di-amonium phosphate was added @ 100 kg/ha. The experiment was sown on 27 June, 2007. The row-to-row spacing was 75 cm, while the plants within the rows were spaced at 30 cm. The crop was protected with three irrigations and to control *Helicoverpa* pod borer one spray each of Endosulfan 35% EC @ 1.0 l/ha and Quinalphos 25% EC @ 2.0 l/ha was applied during reproductive stage. To estimate the cost of production, details of the expenditure were recorded through-out the crop season. The prices of the grain and by-products were estimated using the

prevailing market value in the Indore market and subsequently, the cost of production was worked out.

A sum of Rs 26,395 was spent on the cultivation of one hectare of hybrid seed production programme. Out of this, Rs 6,105 (23.1%) was spent on the inputs such as field preparation, cost of fertilizer, seed, and irrigation (Table 1). The labor cost (Rs 20,290) constituted a major proportion (76.9%) of the hybrid seed production cost. For completing various field operations from sowing to harvesting, a total of 217 man days were used. A breakdown of total labor expenditure revealed that weeding (20.5%) and harvesting (15.9%) were the most expensive manual operations. It was followed by sowing (14.2%) and threshing (11.3%). In this endeavor 1440 kg hybrid seed was obtained from the entire plot. This seed was sold @ Rs 60/kg and it yielded total revenue of Rs 84,000. The estimates of the seed cost derived from these data was Rs.18.85/kg (Table 1). Further, it was also estimated that the hybrid pigeonpea seed production can yield profits as high as Rs 70,000/ha.

The first study on the cost of hybrid seed production of pigeonpea was carried out jointly by ICRISAT and MAHYCO Seed Company in 1979-80 using the first experimental genetic male-sterility based hybrid 'ICPH 2'. The results of this study showed that the hybrid pigeonpea seed can be produced at a reasonable cost of Rs 2.0/kg (Saxena *et al.* 1986). In 1988, Murugarajendran *et al.* (1990) conducted a detailed seed production cost study in Coimbatore using the hybrid parents of 'ICPH 732' the estimated cost of hybrid seed production was Rs. 6.25/ kg. In a similar study conducted at Punjab Agriculture University, Ludhiana by Verma *et al.* (1994) revealed that in 1991 and 1992, the cost of producing one kilogram of hybrid seed was Rs 3.7 and 13.8, respectively. The large differences in the cost observed in the two seasons were primarily attributed to crop management practices, in particular the control of pod borers (*Helicoverpa armigera* and *Maruca testulalis*). Since these pod borers cause huge losses to flowers and developing seeds, their chemical control is essential for recording high hybrid seed yields. Another biological factor that has a significant influence on the hybrid (A x R) yield is the presence of a sufficient number of pollinating insects in the vicinity. The importance of this factor was evident in a series of seed production trials conducted by ICRISAT, Mahabeej, National Seeds Corporation, and other collaborators in farmers' fields in different states. The hybrid seed yield in these trials ranged from 200 to 2000 kg/ha under fairly good crop management regimes (Saxena and Nadarajan, 2010). Muthiah *et al*. (1998) worked out the cost of hybrid seed production of COPH 2 pigeonpea hybrid as Rs. 40 per kg. Around 40 % of cost was incurred on rouguing male fertile plants in the female parental rows.

From the experience of the present study and those conducted earlier on the aspects of hybrid seed production, the following conclusions were drawn.

- The cost of hybrid pigeonpea seed is within the affordable limits of small holder farmers of India.
- The presence of pollinating insects and control of pod borer damage are the two key factors in producing the commercial hybrid seed.
- The staggered planting of pollen parent in a seed production plot helps in the pod set on the female parent rows.
- Clipping of the young pods formed on the pollen parent followed by subsequent irrigation ensures more flower production on pollen plants
- The hybrid seed production of pigeonpea does not require special agronomic package.
- Roguing in both parents is essential and should be completed as soon as or before the flowering commences.
- To control pod borers the spraying operation be taken up in the evening to minimize the damage to the pollinating insects.
- For economical seed production programmes, the sites should be selected very carefully, keeping in mind the availability of pollinating insects in the natural habitat.
- The use of bee-hives in the seed production need expertise and may or may not help in enhancing the hybrid seed yield.
- In suitable sites, the seed yields up to 2000 kg/ha can be obtained.
- The post-harvest treatment of seed is essential.
- The ratio of male and female rows could vary from place to place and it will depend on the bee population in the vicinity.
- Inter-cropping should be avoided in the seed production plots.
- Training of seed producers is essential for good yields.
- There is an urgent need for developing the seed standards for hybrid pigeonpea.

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Table 1. Profitability and cost of hybrid seed production of Pigeon pea hybrid ICPH 2671 at Indore during 2007

Item	Cost (Rs/ha)
Gross expenditure	
(a) Non-labors inputs	
Field preparation	2,000
Fertilizers & seed treatment	3,205
Seed	900
Sub total (a)	6,105
(b) Labor input @ Rs 93.50/day	
Sowing (40)	3,740
Weeding & Intercultur (58)	5,423
Roguing (20)	1,870
Spraying (22)	2,057
Harvesting (45)	4,208
Threshing (32)	2,992
Sub total (b)	20,290
Cost of seed production	
Total expenditure (a+b) (Rs)	26,395
Hybrid yield harvested (kg)	1,400
Cost of producing one kg seed (Rs)	26,395 /1,400 = 18.85
Gross returns (Rs/ha)	
Income from sale of 1400 kg hybrid seed @ Rs 60/kg	84,000
Income from sale of 800 kg R-line seed @ Rs 15/kg	12,000
Income from sale of total fuel wood	400
Total	96,400
Net Profit (Rs / ha)	**96,400 – 26,395 =70,005**