



RESEARCH ARTICLE

Source and seed replacement rate of pea seed in Punjab

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Abstract

The study was conducted to examine the status of pea production in Punjab, the source and use pattern of quality seeds, seed replacement rate (SSR) and various constraints faced by pea growers in Punjab state during 2020-21. A multistage purposive cum random sampling technique was used for the study. The area under pea crop has increased in Punjab with a compound annual growth rate of 3.58 and 10.90%, respectively, during the period 2001-02 to 2020-21. Around 92% of farmers procured pea seed from private dealers, whereas 8% procured it from PAU. In the research area, the seed replacement rate for certified seed for pea crops was 72.09% for large farmers, followed by 65.14% for medium farmers and 46.05% for small farmers respectively. The monopoly of private players in the sale and production of pea seed, adulteration by private dealers and fluctuations in pea seed prices were found as major constraints confronted by the growers.

Keywords: Pea seed, seed replacement rate, adulteration, quality seed

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Introduction

Improved seeds play a positive role in increasing agricultural productivity, improving farmers' livelihoods, and addressing the challenges of climate change and global food security (Erikson et al., 2018). The significance of high-quality seed has another facet. The primary input for high-quality crop productivity or production is seed. Every factor in agriculture production is of secondary importance, but the quality of seeds directly affects agricultural productivity (Kapoor, 2006). Before the green revolution, farmers' primary source of seed was farm-conserved seed, which they preserved, traded, or sold from other farmers. There has been a transition by farmers regarding the source of seed. Earlier, most of the farmers used farm-saved seeds but now they have shifted to certified HYV seeds. Before the green revolution, farmers purchased HYV seeds for cereals and coarse grains from public sector institutions at affordable prices. These HYV seeds benefited not only the farming community but also the nation as a whole (Manjunatha et al., 2015). Later, a number of additional parties became involved in the seed industry as a result of policy changes in the Indian economy and the seed sector in particular. These changes in policy are intended to liberalize, privatize, and globalize Indian sectors, including the seed sector. For instance, the New Policy on Seed Production (NPSD) of 1988 permitted domestic and international private seed corporations to

import seeds and technology and to make investments in the production of seeds (Dastagiri, 2008). Except for self-pollinated crops, where public sector organizations provide farmers with high-quality seeds, farmers' reliance on the seed market has increased at the same time. For a variety of different field crops, vegetable crops, etc., farmers only rely on private seed companies (PSCs). Due to a lack of investment in infrastructure and skilled labor to manage seed production, certification, testing, quality control, and distribution, the function of the public seed sector has degraded over the past few decades. According to reports, the share of the private and public sectors in the official sector's seed industry has apparently reached 60:40 (Govindan, 2003). The non-availability of certified and quality seed has become a major problem for farmers. Seeds of spurious quality with low genetic purity lead to heavy losses in farming. Hence, worth timely availability of quality seeds and compensation in case of crop failure (on account of spurious seeds) are the key issues at the farmers' level (Manjunatha *et al.*, 2015). The share of pea seeds in the variable cost of production is maximum after the labor cost (Singla *et al.*, 2006). However, Punjab's private sector controls the manufacturing and distribution of pea seeds. Early in the season, the cost is relatively high; during the main season, the cost drops. The production and distribution of pea seeds are unaffected by government action. The climate is not suitable for pea seed production in Punjab and the pea seeds come from the neighboring state of Uttar Pradesh. However, there hasn't been a lot of research on pea seeds in Punjab, so the current study was carried out to study the pea crop production in Punjab and to examine the source and seed replacement rate (SRR) of pea seed by chosen farmers, and to discover the issues that chosen pea growers have with pea seed availability.

Material and Methods

The study was based on both primary and secondary data to achieve the objectives of the study. For Secondary data, various issues of the Statistical Abstract of Punjab and online portal were used to collect the district-wise data of pea and vegetable crops for the period of 2001-02 to 2018-19. For the agricultural crop year 2021-2022, primary data were gathered using a multistage purposive cum random sampling technique. In the first step, a major pea-growing district was selected using secondary data. Two of the highest pea-producing blocks were purposefully chosen in the second step of sampling, and two villages were randomly chosen from each of the selected blocks in the third step of the selection of sample. In the end, 30 farmers from each selected village were chosen, creating a sample of 120 pea growers for the study. The cube root frequency approach was used to classify the farmers into small, medium, and large groups according to the area planted with peas. Descriptive tools were used to calculate

the average, percentage and, sparkling graphs, etc. The compound annual growth rate was used to calculate the growth rate of the area and production of both pea and vegetable crops.

Seed replacement rate (SSR)

The Seed replacement rate (SRR) for the pea crop with the sample farmers for certified seeds in 2019-20 was determined by dividing the proportion of certified seed used in the pea crop by the total amount of seed used. It was worked out by taking a percentage of the certified seed to the total seed used for a particular crop.

The formula calculated seed replacement rate (SRR): -

$$SRR = \frac{C \times 100}{A \times K}$$

Where,

SRR = Replacement rate of seeds for a pea crop

C = usage of certified seeds by farmers

A = area under the crop

K = seed rate per unit of area.

Results and Discussion

The total cropped area was 7941 thousand hectares in 2001-02, which decreased to 7825 thousand hectares in 2019-20 (Table 1). The area under vegetables increased from 135 thousand hectares in 2001-02 to 264.59 thousand hectares in 2019-20. The proportion of area under vegetables to total cropped area (TCA) had increased from 1.70% to 3.38% from 2001-02 to 2019-20, respectively. But the area under pea had a tremendous increase in Punjab state from 14.50 thousand hectares to 14.40 to 41.35 thousand hectares in 2019-20. In percentage terms, it had demonstrated an increase in the proportion of area under pea to total crop area, i.e., 0.18% in 2001-02 to 0.53% in 2019-20. On the other hand, the proportion of area under vegetable crop to total cropped area (TCA) had increased from 10.67 to 15.63% in the same year.

As compound annual growth rate is concerned, an area under the pea crop increased at a growth rate of 3.58% from 2001-02 to 2010-11, whereas the area under the pea crop increased by 10.90% from 2011-12 to 2020 (Table 2). The overall compound growth rate in the case of the area under the pea crop was 6.01%. Production was 10.48 and yield was 4.22%, which was significant at a 1% level of significance during the period 2001-02 to 2010-11, respectively. It might be due to the introduction of high-yielding hybrid varieties of pea crops in the Punjab state.

Table 3 shows the district-wise area under pea crop in Punjab state from the period 2010-11 to 2018-19. The result of data depicted that the maximum area under pea crop observed in the case of Amritsar district it was 18.308 thousand hectares, followed by Hoshiarpur district (6.106 thousand hectares) and SBS Nagar (3.116 Thousand hectares) for the period of 2018-19, respectively. The result of sparkline

Table 1: Total cropped area (TCA) and area under vegetables and pea in Punjab, 2001-02 to 2019-20

Year	TCA*	Area under vegetable	Area under pea	Area under vegetable as % of TCA	Area under pea as % of TCA	Area under pea as % of area under vegetable
2001-02	7941.00	135	14.40	1.70	0.18	10.67
2002-03	7772.64	138.3	14.50	1.78	0.19	10.48
2003-04	7906.82	153	16.00	1.94	0.20	10.46
2004-05	7930.75	158.6	16.70	2.00	0.21	10.53
2005-06	7867.52	152.07	17.21	1.93	0.22	11.32
2006-07	7860.68	166.8	18.10	2.12	0.23	10.85
2007-08	7869.69	171.6	18.50	2.18	0.24	10.78
2008-09	7912.18	178.41	18.49	2.25	0.23	10.36
2009-10	7875.44	183.35	19.05	2.33	0.24	10.39
2010-11	7883.02	174.1	19.70	2.21	0.25	11.32
2011-12	7904.73	178.2	19.70	2.25	0.25	11.05
2012-13	7870.14	184.1	20.33	2.34	0.26	11.04
2013-14	7847.66	191.02	20.54	2.43	0.26	10.75
2014-15	7857.32	208.03	22.15	2.65	0.28	10.65
2015-16	7871.57	213.9	31.30	2.72	0.40	14.63
2016-17	7804.36	232.44	35.38	2.98	0.45	15.22
2017-18	7778.99	244.35	37.62	3.14	0.48	15.40
2018-19	7850	249.32	38.81	3.18	0.49	15.57
2019-20	7825.00	264.59	41.35	3.38	0.53	15.63

Source: indiastat.com; ('000 Hectares), *TCA-total cropped area

graphs depicted that the area under pea crop has increased in almost all the districts of Punjab as well for the Punjab state except Hoshiarpur district, which shows the up and down trend in the area under pea during the study period. The proportion of area under pea crop showed an increase from the year 2010-11 to 2018-19 in the case of Amritsar, SBS Nagar, Tarn Tarn, Ludhiana, Jalandhar, Ferozepur district and Punjab state itself. However, the proportion of the increase in the rest of the remaining districts, namely Patiala, Sangrur, Gurdaspur, Kapurthala, Fatehgarh Sahib and others, did not follow the same pattern that the above-stated district had in the study period.

The main varieties grown by the selected farmers were Azad Pea-3 for the early season and Punjab-89 and GS-10 for the main season (Table 4). For selected small farmers, about 78 per cent of farmers procured Azad Pea-3 for an early season; about 13% procured the GS-10 variety, while 10% depended on the Punjab-89 variety for the main season. In the case of medium farmers, 80% of the selected farmers procured Azad Pea-3 for the early season, about 13% procured Punjab-89 and about 8% procured GS-10 variety for the main season. Furthermore, in the case of large farmers, 90% of the selected farmers procured the Azad Pea-3 variety for an early season, 5% of the selected farmers procured Punjab-89 and almost 5% of selected farmers procured the GS-10 variety for the main season. Overall, in the study area, 83% of the farmers procured Azad Pea-3 for the early season, 9% of the farmers procured Punjab-89, and 8% of the farmers procured a GS-10 variety of pea for the main season.

The seed rate is the quantity of a crop's seed needed to sow a unit area of land for optimum crop production. For higher yield harvesting or optimum plant production, it is necessary that farmers can use the recommended seed rate. The recommended seed rate by PAU for pea crops is different for early and main season varieties, i.e., 45 kg/acre for early season and 35 kg/acre for main season varieties (Thind and Mahal, 2021). The seed rate adopted was highest among medium farmers, followed by selected large farmers and small farmers in the study area (Table 5). The recommended seed rate for Azad Pea-3 is 45kg/acre but the farmers used more than the recommended seed rate by PAU. Overall, the actual seed rate used by the farmers in the study area was 63.3 kg/acre for the early season Azad Pea-3 variety, 42.3 kg/acre for the main season Punjab-89 pea variety, and 40.5 kg/acre for the main season GS-10 pea variety. The reason for the use of an increased seed rate than recommended by PAU was an admixture of spurious seeds with pure seeds. Another reason of the high seed rate observed at the field level was that farmers sow pea crops earlier than

Table 2: Area, Production and Yield of Pea in Punjab from 2001-02 to 2020-21

Year	Area (000,ha)	Production (000 MT)	Yield (MT/ha)
2001-02 to 2010-11	3.58***	6.71***	3.02***
2011-2012 to 2020-21	10.90***	11.39***	0.44***
2001-02 to 2020-21	6.01***	10.48***	4.22***

Source: indiastat.com

***indicates statistically significant at 1% level

Table 3: District-wise area under pea crop from 2010-11 to 2018-19 in Punjab.

District	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Graph
Amritsar	5.197	5.066	5.13	5.916	7.138	14.812	17.585	18.295	18.308	
Hoshiarpur	6.606	6.496	6.55	5.662	5.016	5.286	5.496	5.805	6.106	
SBS nagar	1.858	1.881	1.91	1.924	2.012	2.314	2.586	2.915	3.116	
Patiala	1.504	1.55	1.599	1.604	1.654	2.004	2.085	2.196	2.207	
Tarn tarn	0.99	1.375	1.36	1.369	1.648	1.652	1.708	1.806	1.895	
Ludhiana	0.543	0.613	0.715	0.724	0.986	1.212	1.296	1.315	1.386	
Jalandar	0.81	0.74	0.822	0.852	0.832	0.89	0.985	1.086	1.106	
Sangrur	0.554	0.505	0.587	0.598	0.742	0.744	0.812	0.915	0.976	
Gurdaspur	0.404	0.374	0.387	0.496	0.497	0.504	0.568	0.575	0.596	
Kapurthala	0.265	0.273	0.326	0.373	0.382	0.384	0.412	0.516	0.616	
Ferozepur	0.146	0.1	0.114	0.124	0.194	0.414	0.435	0.595	0.707	
Fathergarh	0.134	0.143	0.162	0.173	0.172	0.174	0.245	0.275	0.316	
Others*	0.653	0.585	0.664	0.729	0.876	0.912	1.171	1.329	1.483	
Punjab	19.664	19.701	20.326	20.544	22.149	31.302	35.384	37.623	38.818	

Source: indiastat.com, (000 Hectares)

the recommended time. The recommended time for good pea yield is October end to middle of November (Thind and Mahal, 2021)

The percentage share of seed cost component in total variable cost for early season pea variety was maximum (40.26%), followed by a share of labor cost (32.89%). The percentage share of labor cost in the total variable cost was maximum, as shown in Table 6, as compared to other variable components. In the case of the main season, the portion of pea seed varieties was 27.19% of their total variable cost and 40.26% in the case of early varieties of pea seed in the Amritsar district of Punjab state. The reason for the lower seed cost in main season pea varieties was that the majority of farmers procured seed of main season pea variety from PAU, which has a high germination rate, low price and lower seed rate. Labor cost was higher in the main season variety due to higher yield, which led to an increase in picking cost. When compared to main season varieties, the overall variable cost was similarly greater for early season varieties. It cost Rs. 22,132 for the early season's pea varieties and Rs. 21,106 for the main season's varieties. The early season pea variety's net return was Rs. 47868, whereas

the main season variety's net return was Rs. 30894. The net return was higher for the early season variety because of the high price in early winter.

Punjab does not produce the varieties of pea seed; instead, it is imported from Uttar Pradesh, in contrast to the production of wheat and paddy seeds, pea seed production is controlled by private parties. Prices for pea seeds fluctuate with the market and are entirely determined by market factors. Private seed dealers sell pea seeds, and they charge as much as the price they want. The prices of pea seeds are higher for the early season and low for the main season. Overall, in the Amritsar district, 91% of the farmers procured pea seeds from private seed dealers, while 9% procured seeds from PAU (Table 7).

Seed replacement rate (SRR) of sample farmers

The number of generations up to which the seed could be used from the previous crop without resorting to renewal is another important aspect, important for the maintenance of the productivity of crops. The deterioration in seed quality may result from physical admixtures and loss of genetic vigor and germination power. As discussed earlier, pea seed is not produced in Punjab due to harsh climatic conditions. It is produced in Uttar Pradesh due to favorable climatic conditions. After procuring pea seeds from Uttar Pradesh,

Table 4: Variety-wise area of pea cultivated by selected farmers in Amritsar district of Punjab

Farm category	Varieties of pea		
	Early season	Main season	
	Azad Pea-3	Punjab-89	GS-10
Small farmer	31 (77.50)	4 (10.00)	5 (12.50)
Medium farmer	32 (80.00)	5 (12.5)	3 (7.50)
Large farmer	36 (90.00)	2 (5.00)	2 (5.00)
Overall	99 (82.5)	11 (9.16)	10 (8.33)

Note: Figures in the parenthesis is the percentage to the total area in Punjab.

Table 5: Pea Seed Rate in Amritsar district of Punjab (kg/acre)

Farm category/ varieties	Early Season	Main Season	
	Azad Pea-3	Punjab-89	GS-10
Small farmer	62.5	42.5	40.5
Medium farmer	64	43	41
Large farmer	63.5	41.5	40
Average	63.3	42.3	40.5
Seed Rate by PAU	45	35	35

Table 6: Cost and Returns from pea cultivation in Amritsar district of Punjab

Particulars	Early Season		Main Season	
	Rs	Percentage Share	Rs	Percentage Share
Seed (Kg)	8912.5	40.26	5737	27.18
Urea (Kg)	532	2.4	543	2.57
DAP (Kg)	2224	10.04	2326	11.02
Potash (Kg)	691	3.12	700	3.31
Irrigation (Rs)	300	1.35	270	1.27
Human Labour (Rs)	7280	32.89	9384	44.46
Marketing and transportation charges (Rs)	1240	5.6	1248	5.91
Interest@9% for the half of the crop period (Rs)	953	4.3	909	4.3
Total variable cost (Rs)	22132	100	21106	100
Yield (qtls)	20	-	30	-
Gross Returns (Rs)	70000	-	52000	-
Return over variable cost (Rs)	47868	-	30894	-

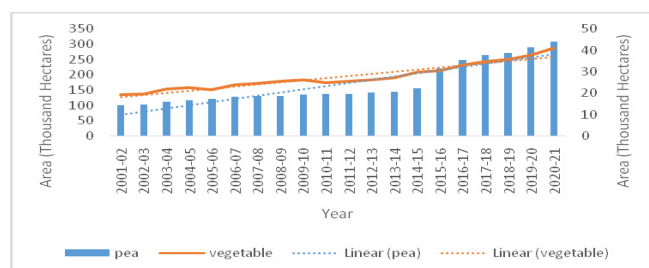


Figure 1: Area of pea and vegetables in Punjab state

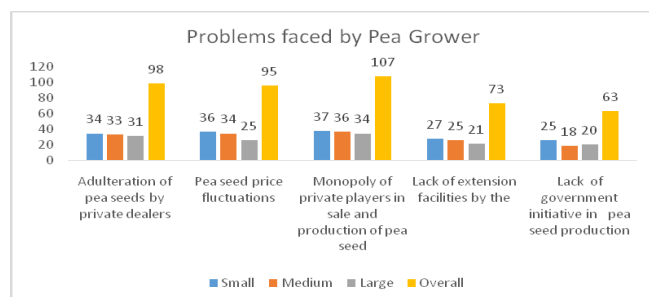


Figure 2: Problems faced by pea growers regarding pea seed in the Amritsar district

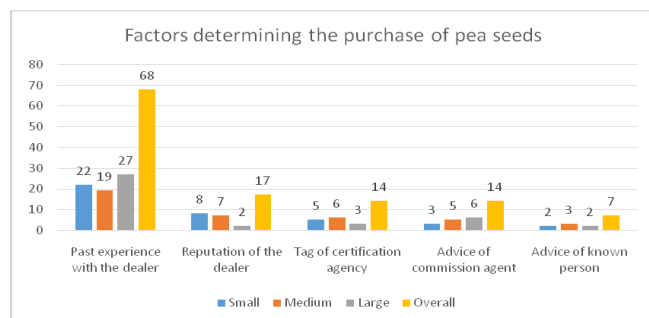


Figure 3: Factors determining the purchase of pea seeds by the pea growers in Amritsar district

pea seed dealers in Punjab sell them to farmers in Punjab. The pea growers in the study area replace pea seeds yearly as they do not store them. Azad Pea-3 variety of pea is used for pea production in the early season, whereas GS10 and Punjab 86 were procured by the farmers in the main season for pea production in the study area.

Seed Replacement Rate was directly proportional to the farm size. As the farm size increased, the seed replacement rate also increased. It was 46% for small farmers, 65% for medium farmers and 72% for large farmers (Fig 3). The average seed replacement rate for the chosen farmers was found to be 62%. The results were in line with the study conducted by Kalsi *et al.* (2022) where it was found that seed replacement rate was directly proportional to farm size.

An opinion survey was conducted in the research region to learn about the issues/restraints that the farmers depicted in Fig 2 encountered. Among small farmers, the main problem faced by the pea growers was the monopoly of the private players in the production and sale of pea seed, followed by fluctuations in pea seed price and adulteration of pea seed (85%). In the case of medium farmers, it was due to the monopoly of private seed players in the production and sale of pea seeds, followed by price fluctuations of pea

Table 7: Source for Pea seed with selected farmers in Amritsar district of Punjab

Farm Category/ Seed Distributors	Private Dealers	PAU (Punjab 89)	Overall Farmers
Small	37 (92.50)	3 (7.50)	40 (100)
Medium	35 (87.50)	5 (12.50)	40 (100)
Large	38 (95.00)	2 (5.00)	40 (100)
Total	110 (91.66)	10 (8.33)	120 (100)

seeds and mixing of poor-quality pea seeds. In the case of large farmers, the majority of the farmers faced the problem of a monopoly of private seed players in the production and sale of pea seeds and the issue of adulteration in pea seeds while cultivating pea crops. The overall scenario showed that in the case of Amritsar district, the monopoly of the private seed players in selling and producing pea seed, adulteration of pea seeds by private players, and pea seed price fluctuations and extension or training facilities were the major constraints faced by pea growers. The results are in line with the study conducted by Kaur et al. (2018) where it was found that seed purity and lack of extension and training facilities are significant problems faced by the pea growers in the region.

The main factors determining the purchase of pea seeds in the study area are shown in Fig 3. It depicted that most study farmers reported bad experiences with dealers while purchasing the seed as they did not have good facilities, non-timely availability of seed, proper communication, etc. The reputation of the private dealers in the area, reported by 20% of small farmers, 18% of medium farmers, and 5% of large farmers, also had an impact on the purchase of pea seeds. The third important factor was the tag of the certification agency, which reveals whether pea seed is certified or not. Only 13% of small farmers, 15 medium farmers, and 8% of large farmers found it effective in decision-making for the purchase of pea seed. The commission agent's recommendation was the fourth crucial element, and it had an impact on the purchasing decisions of 8% of small farmers, 13% of medium farmers, and 15% of large farmers. The decision to purchase pea seeds was influenced by the advice of a friend or family in 5% of cases for small farmers, 8% for medium farmers, and 5% for large farms.

Conclusion

Around 92% of farmers procured pea seed from private dealers, whereas 8% procured it from PAU. However, it was also observed that the actual seed rate was higher than PAU's recommended seed rate. Pea seeds made up

as much as 40.26% of the total cultivation expenditures for the early season pea variety and as much as 27.18% of the total cultivation costs for the main season pea variety, respectively. The study suggested reducing private parties' contribution to pea seed production and sales. The government should produce pea seeds to investigate pea production in the region because of their quick growth, low cost of production (unlike fruits), and rising demand.

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सारांश

यह अध्ययन पंजाब में मटर उत्पादन की स्थिति, गुणवत्ता वाले बीजों के स्रोत और उपयोग पैटर्न, बीज प्रतिस्थापन दर (एसएसआर) और 2020-21 के दौरान पंजाब राज्य में मटर उत्पादकों द्वारा सामना की जाने वाली विभिन्न बाधाओं की जांच करने के लिए आयोजित किया गया था। अध्ययन के लिए एक बहुस्तरीय उद्देश्यपूर्ण सह यादृच्छिक नमूनाकरण तकनीक का उपयोग किया गया था। 2001-02 से 2020-21 की अवधि के दौरान पंजाब में मटर की फसल का क्षेत्रफल क्रमशः 3.58 प्रतिशत और 10.90 प्रतिशत की चक्रवृद्धि वार्षिक वृद्धि दर के साथ बढ़ा है। लगभग 92 प्रतिशत किसानों ने निजी डीलरों से मटर का बीज खरीदा, जबकि 8 प्रतिशत ने पीएयू से खरीदा। अनुसंधान क्षेत्र में, मटर की फसल के लिए प्रमाणित बीज के लिए बीज प्रतिस्थापन दर बड़े किसानों के लिए 72.09 प्रतिशत थी, इसके बाद मध्यम किसानों के लिए 65.14 प्रतिशत और छोटे किसानों के लिए 46.05 प्रतिशत थी। मटर के बीज की बिक्री और उत्पादन में निजी खिलाड़ियों का एकाधिकार, निजी डीलरों द्वारा मिलावट और मटर के बीज की कीमतों में उतार-चढ़ाव को उत्पादकों के सामने आने वाली प्रमुख बाधाओं के रूप में पाया गया।