



## Adoption of Yellow Sarson (*Brassica campestris* L.) in District Udham Singh Nagar of Uttarakhand

Jitendra Kwatra<sup>1</sup>, Ajay Kumar Prabhakar<sup>2</sup>, Pratibha Singh<sup>3</sup> and Ankita Bhatt<sup>4</sup>

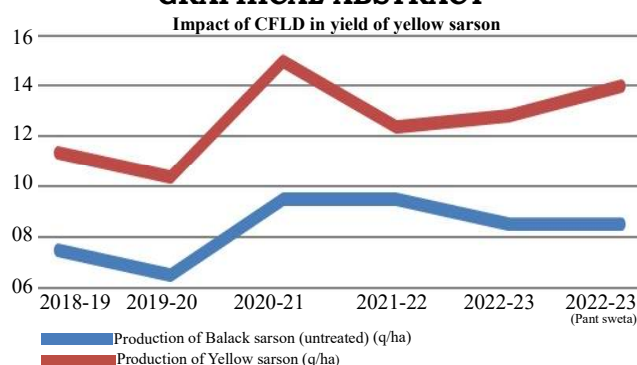
1. Director, Ext. Edu., 2. SMS, KVK, Kashipur, 3. Assoc. Director (HSci.), K.V.K. Kashipur, 4. Project Coordinator, DST-WTP (SEED) Project, GBPUA&T, Pantnagar, Udham Singh Nagar, Uttarakhand

Corresponding author's e-mail: bhattankita.gbpuat@gmail.com

### HIGHLIGHTS

- The study examines the impact of KVK intervention on the yield of Yellow Sarson on farmer's field with the use of improved package of practice.
- The study shows the impact of oilseed cultivation on socio economic factor.
- The study reveals the statistical significance between PPS1 and untreated black sarson.

### GRAPHICAL ABSTRACT



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### ABSTRACT

*Context:* KVK, is promoting and disseminating the knowledge and technical know-how about new varieties for the quantitative and qualitative production of farmers.

*Objectives:* The study aimed to assess the impact of KVK intervention on the adoption of Yellow Sarson by the farmers.

*Methods:* The study was carried out in Uttarakhand during 2018-23 in the operational villages of Krishi Vigyan Kendra (KVK), Kashipur, district Udham Singh Nagar. Data was collected using structured schedule developed based on the objective of the study. Statistical tools namely frequency, percentage, weighted mean and t-test were calculated to interpret the data.

*Results & Discussion:* It was found that the seed average yield of Yellow Sarson was 12.65 q/ha in demonstration field as compared to seed obtained from farmers field (8.38 q/ha). The highest increase in yield was observed in the year 2022-2023 (64.70 %). The average pooled data results of the demonstrations conducted by KVK, Kashipur from 2018-19-2022-23 showed the average gross cost (Rs /ha), gross return (Rs /ha) and net return (Rs /ha) as 25000 Rs /ha, 61833.1 Rs /ha and 36833.1 Rs /ha, respectively. Benefit cost ratio (B - C) was found as 1.72, 1.82, 2.66, 3.22, 2.58, and 2.82 for the years 2018-19, 2019-20, 2020-21, 2021-2022, 2022-2023 and 2022-2023, respectively. An increase of 16.80 per cent has been found in demonstrations yield as compared with district yield. The substantial yield is attributed due to introduction of new variety in CFLD (Cluster front line demonstration) mode which facilitated better crop management.

*Significance:* The study emphasizes the impact of KVK FLD programmes for the inclusion of new improved variety of Sarson and examines the extent of impact of extension activities in adoption of Yellow Sarson by the farmers.

**M**ustard is one of the major oilseed crops produced in Uttarakhand. About 18 per cent of India's total oilseeds production is made up of rapeseed and mustard. With an average productivity of 1339 kg per hectare, the crop covers 6.19 million hectares and yields 8.14 million tons (ICAR-DRMR, 2018). The favourable agro-climatic conditions in Uttarakhand support mustard cultivation, making it one of the primary oilseed crops in the region. As per the Reports, 2023 due to the effect of COVID-19 pandemic it is estimated that Mustard Oil market size will be of USD 46 million i.e. in view of the ever-increasing population, vegetable oils and fats are expected to be much more equilibrated in coming years. According to the directorate of agriculture and state's directorate of economics and statistics, the state had around 7.7 lakh hectares of net sown area in 2000-01, but it has now come down to 6.47 lakh hectare whereas officials cite migration, disasters and urbanization as major reasons for this trend (Jha, 2021).

For improvement in productivity there is a need of crop diversification in agriculture and farmers should be exposed to improved methods of cultivation which is a crucial stress-relieving strategy for the economic expansion of farming community (Rathore *et al.*, 2002). Diversification has become important now-a-days as productivity of the most of the crops is low in the country, and there is a huge scope to raise the productivity to enable increase in farmers' income. In India, crop diversification is generally considered to be a shift from traditional less remunerative crops to more remunerative crops. Major advantages of crop diversification include increases in income of small farm holdings; less risk for price fluctuation, climatic variability and balancing food demand (Khanam *et al.*, 2018).

For making country self-sufficient in edible oil, Government of India has taken several initiatives in making policies since 1986. Total consumption of edible oil in 2022-23 is 278.6 lakh ton in which 123.3 lakh ton was domestically available (Department of Agriculture and Farmers Welfare, 2023) and 155.3 lakh ton was imported (B.L. Mangaluru Bureau, 2023) to fulfill the demand of edible oils. Therefore, it is necessary to adopt diversification in the production of edible oils to maximize production to ensure edible oil security for the country. Keeping in view the importance of crop diversification, the study on yield of Yellow Sarson (Oilseed) by keeping black sarson (untreated) yield in check in Udham Singh Nagar,

the Cluster Field Demonstration programme was conducted for the holistic development of farmers in terms of production, health and economic gains.

## METHODOLOGY

The study was conducted in Udham Singh Nagar district of Uttarakhand (28.98°N 79.40°E) during 2018-2023 in the jurisdiction of KVK as present in Fig.1. The study area is located at 29.210 latitude and 78.961 longitude and an altitude of 4.3 km above MSL.

As the study needs to find the adoption of the new variety of Yellow Sarson by the farmers, a descriptive research design was used for the study. To observe and record any changes over a period of time on crop, the longitudinal study design was performed under which the demonstration variety was sown for 6 consecutive years. Area under demonstration for Yellow Sarson was identified under Cluster Frontline Demonstration programme (National Food Security Mission) from the year 2018 to 2023. For this experiment 10 ha and 75 ha area was selected for six different consecutive years (i.e. from 2018 to 2023). The variety 'PPS-1 and Pant Shewta' were used in the demonstrated fields and farmer's field. As part of the improved package of practices, fertilizers, herbicides, irrigation applications and plant protection measures have been implemented. A structured schedule was constructed to measure the impact of KVK FLD programmes on farmers' yield. The schedule consisted of four components viz. economic analysis on Yellow Sarson production, extension activities and observation on Yellow Sarson production technology, assessment of socio-economic status of the farmers and Yield Gap Minimized (q/ha) (%). Based on the study objectives, data have been gathered by means of an integrated schedule. Statistical tools namely frequency, percentage, mean,



**Fig. 1. Location map of study area, Udham Singh Nagar**

variance and t-test were calculated to interpret the data. The variances of the check and demo crops were used to apply t test. Based on the value of variances, if variances are unequal and  $n_1 = n_2$ , the formula used (ICAR, 2013) for t test was:

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

It follows a t distribution with  $(n_1+n_2/2)-1$  degree of freedom.

Where  $\bar{X}_1$  and  $\bar{X}_2$  are the means of two groups demo crop and check crop grown by farmers respectively, and are  $s_2$  the standard deviations of two groups,  $n_1$  and  $n_2$  are the sample sizes of two groups.

**RESULTS**

The impact of CFLD programme on *Brassica campestris* L. var. yellow sarson in U.S. Nagar district of Uttarakhand in terms of yield performance,



**Fig.2. Average economic parameters**

economic analysis, extension activities, socio economic factor, yield gap and assessment of yield obtained are displayed as below.

*Yield performance:* The results of the demonstrations conducted by KVK, Kashipur from 2018 to 2023 is shown in Table 1 and Fig.2. During the years pooled data of FLD programme, it was found that the seed average yield of Yellow Sarson was 12.65 q/ha in demonstration field as compared to black sarson (untreated) seed production (8.38 q/ha). The increase in yield was observed highest for the demonstration variety PPS1 in the year 2022-23 (i.e. 64.70%) followed by yield in the year 2020-21 (i.e. 57.89%). The least increase in yield was observed in the year 2021-22 (i.e. 26.53%). The average per cent increase in yield from 2018-2023 was found as 48.09 per cent (i.e. 4.27 q/ha).

Similar results were also shown by Dayanand *et al.* (2012), Ahmad *et al.* (2013) and Chauhan *et al.* (2020). The results clearly indicated the potential of technologies resulting in an increase in yield at farmers' level.

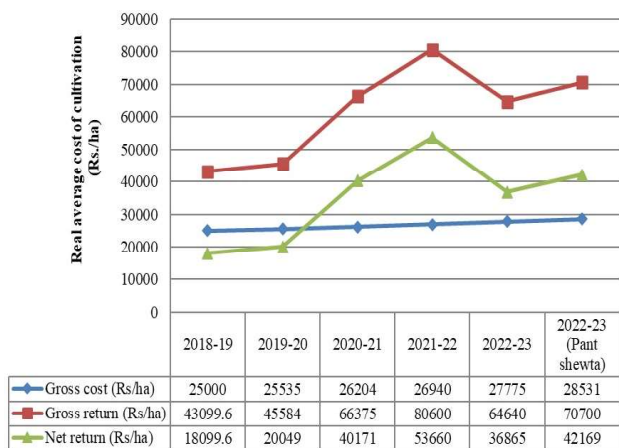
*Economic analysis:* Net return and benefit: cost ratio realized from 2021-22 (3.22) were higher than 2018-19 (1.72), 2019-20 (1.82), 2020-21(2.66), 2022-23 (2.58 for Pant Shweta) and 2022-23 (2.82 for PPS1) (Table 1). It was observed that maximum increase in profit was observed in the year 2022-23 for the demonstration variety PPS1. The average pooled data results of the demonstrations conducted by KVK, Kashipur from 2018-19 to 2022-23 showed the average Gross Cost (Rs /ha), Gross return (Rs /ha) and Net Return (Rs /ha) as 26664.2 Rs /ha, 61833.1

**Table 1. Yield performance and Economic analysis on Yellow Sarson production**

Year	Area (ha)	No. of demo.	Variety		Yield obtained (q/ha)		Yield increase (%)	B:C ratio	
			Check	Demo	Check	Demo		Check	Demo
2018-19	10	30	Black sarson (State average)	PPS 1	7.5	11.34	51.20	1.14	1.72
2019-20	75	125	Black sarson (Untreated)	PPS 1	6.5	10.36	37.26	1.14	1.82
2020-21	10	20	Black sarson (Untreated)	PPS 1	9.5	15	57.89	1.98	2.66
2021-2022	10	15	Black sarson (Untreated)	PPS 1	9.8	12.4	26.53	2.54	3.22
2022-2023	10	23	Black sarson (Untreated)	Pant Shweta	8.5	12.8	50.59	1.717	2.58
2022-2023	10	27	Black sarson (Untreated)	PPS 1	8.5	14	64.70	1.717	2.82
Seed average yield					8.38	12.65	48.09		

**Table 2. Extension activities and observation on Yellow Sarson production technology**

Parameter	2018-19	2019-20	2020-21	2021-2022	2022-2023	No/ Remarks
Field day	2	2	2	3	2	11
Kisan gosthi	1	2	1	3	2	09
Capacity Building program	1	3	3	4	3	14
Field visit	18	24	17	36	31	126
Mobile advisory	28	52	39	36	38	193
Farmer's feedback	Yield potential of the variety is high, Farmers like this variety					
Scientist observation	If farmers have suitable seed drill for the sowing of rapeseed mustard, the cost of cultivation may have reduced (labour for thinning etc) for optimum plant population maintenance and farmer obtains optimum yield					



**Fig.3. Trend observed from 2018-23 in average gross cost, return and net return from the crop**

Rs /ha and 35169 Rs /ha, respectively (Fig. 2) and the trend observed in gross cost, return and net return is given in Fig.3.

*Extension activities:* These activities and observation are reported in Table 2 which showed the field days, kisan gosthi, capacity building program, field visit and mobile advisories which were taken as parameters

**Table 3. Impact of oilseed cultivation on socio economic factor**

Parameters	Impact (After CFLD)
Economic gains (Average)	Rs. 36000 to Rs. 46000
Area expansion (%)	20
Adoption of technology by farmers (%)	35
Diversification of area (%)	20
Satisfaction level (%)	65

**Table 4. Yield gap minimized (q/ha) (%)**

Variety: PPS1 (2022-2023)	District yield (D)	Av. Demo. yield	State Yield (S)	Potential Yield (P)	% increase from district yield	% increase from state yield
Yield Gap Minimized (q/ha) (%)	10.83	12.65	8.03	17.22	16.80	57.53

for the training and guiding purpose to give the suggestions, directions and solutions to farmer's problems regarding cultivation of Yellow Sarson. It was observed the increase in yield with the increase in capacity building programme which confirmed with the work of Sharma *et al.* (2004) and Rathore *et al.* (2003). Farmer's reported yield potential of the variety is high.

*Socio economic factor:* There has been a substantial increase in area of Yellow Sarson in last few years. The impact of oilseed cultivation is shown in Table 3. Under the parameter economic gains the average gain ranged from Rs. 36000 to Rs. 46000. As per the area expansion and diversification of area 20 per cent increase was observed in both parameters and 35 per cent increase was measured under adoption of technology by farmers. The majority (65%) of farmers were satisfied with the CFLD programme and its outcome which is in line with the results of Singh *et al.* (2007). The increase in yield showed a 35 per cent adoption of suggested and demonstrated technology which is in line with the results of Rai *et al.* (2012) and contradicted the results of Sachan *et al.* (2005).

*Yield gap:* Due to the impact of extension activities of K.V.K. and district line department the positive observations were seen in Yield Gap Minimized (q/ha) percentage during the year 2022-23 for PPS1 variety of Yellow Sarson (Table 4). As per the average demonstration yield there was an increase of 16.80 per cent and 57.53 per cent as compared to district yield and state yield respectively. The results are in conformity

**Table 5. t - calculated values of two independent variables with same sample size (n=6)**

Treatment	Mean	SD	SE	t value
Demo	12.65	1.696	0.758	4.481
Check	8.38	1.295	0.579	

*t*-value at 0.01 level of significance (*df* = 10) = 2.764,  
*t*-value at 0.05 level of significance (*df* = 10) = 1.812

with the findings of Dutta, 2014.

*Assessment of yield obtained (q/ha) by check (Black Sarson) and demo (PPS I) crops in the farmer's field:*

Now in Table 5 we dealt with effectiveness of techniques utilized by the farmers using equal amount of fertilizers, herbicides, irrigation application and plant protection measures in sowing Black Sarson and PPS 1 variety of Yellow Sarson. The hypothesis is tested statistically with variety wise distribution of PPS 1 and Black Sarson mean and standard deviation mean difference between demo and check. Significance of difference at 1 per cent and 5 per cent level of significance is tested with student's paired 't' test and tabulated 't' value is compared with calculated 't' value.

As per the above Table 5, the calculated t of 4.481 exceeds the critical t of 1.812 (5% LOS) and 2.764 (1% LOS) i.e. the relationship was found to be significant at both 0.05 and 0.01 level of probability. Therefore, there is less than one per cent chance that the difference in depression level is due to mere chance. Large observed difference in depression level is probably due to the difference in treatment i.e. variety sown.

## DISCUSSION

The study was conducted to popularize and adoption of Yellow Sarson by the farmers in selected areas under the Cluster Frontline Demonstration programme in Udham Singh Nagar, Uttarakhand. The yield performance was better (i.e. 26.53% - 64.70%) in CFLD's field. This may be due to the adoption of technology, package of practices such as seed treatment, doses of fertilizers, and plant protection measures recommended by the scientists. The results obtained by the study of Ahmad *et al.*, (2013) mentioned climate conditions and variation in agriculture practices as the prime reason for variation in yield. The net return was found maximum in the year 2021-22 as Kisan gosthi, capacity-building programmes, and field visits were practiced maximum in this period which resulted increase in awareness among the farmers regarding the package of practice. The study of Sharma *et al.* (2004) also showed that training received, scientific orientation,

knowledge of improved variety of seed production technology, utilization of information sources, and regular contact with the scientists positively correlated and highly significant with the production level. The majority of the farmers were satisfied with the technology transferred and the yield obtained by them and this is due to the successful implementation of the technology which had a good impact on the farming community (Singh *et al.*, 2007). Moreover, extension activities can be increased by adding more training and awareness programmes, field visits, capacity-building programmes, regular growth monitoring, Kisan gosthi, etc. In the statistical assessment, the yield in the check and demonstration field was found significant from which it was concluded that the difference observed was due to the variety sown in different fields. By seeing the economic gains of adopting the new technology of Yellow Sarson, observed a 20 per cent diversification of area. If we consider the increase in yield and economic gain as prime factors to motivate other farmers to adopt of technology of Yellow Sarson variety to increase the adoption rate and diversification of technology practices.

## CONCLUSION

The increase in yield by farmers showed 35 per cent adoption of suggested and demonstrated technology which was observed highest for the demonstration variety PPS1 in the year 2022-23 (i.e. 64.70%). When it came to an increase in profit, it was observed that in the year 2022-23, the profit was found maximum for the demonstration variety PPS1. Under economic gains the average gain ranged from Rs. 36000 to Rs. 46000. As per the area expansion and diversification area 20 per cent increase was observed in both parameters. The per centage of farmers who were found satisfied with the CFLD programme and its outcomes was 65. As per the difference in the variance of demo and check crops, it was found that the large observed difference in depression level is probably due to the difference in treatment i.e. variety sown. It may be concluded that the production of Yellow Sarson in Udham Singh Nagar is beneficial for the farmers in economic terms and crop diversification. The demonstrations on Yellow Sarson and extension activities have sensitized farmers towards the production of oilseeds and found profitability in rapeseed including health benefits. Therefore, efforts are required to evaluate the rising trend in procurement prices and yield will help farmers

expansion of its cultivation in the future.

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**Declaration of competing interest:** Author has no competing interests.

**Data availability:** Data would be made available on request.

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**Appendix:** The supplementary data, table, graph in jpeg format for online visibility to the readers are submitted as an appendix.

**Authors' contribution:** Author first & third are conceptualization, supervision, review and editing, Second author operationalization of the study. Author fourth is formal analysis, perceived concepts, review, edits and prepared original and final manuscript. The data was analysed, interpreted and written as a research article. The authors approve the content of the manuscript and agree to be held accountable for the work.

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