***Original Research Article***

**DOCUMENTATION OF CAULIFLOWER (*BRASSICA OLERACEA VAR. BOTRYTIS*) CULTIVATION PRACTICES: INSIGHTS FROM JAMMU & KASHMIR (UT), INDIA**

**Abstract**

A descriptive study was conducted in the Jammu district of Jammu region, Jammu and Kashmir (Union Territory) in 2020-2021 to explore the ground level adoption of cauliflower cultivation practices in Jammu region, as J&K (UT) stands out for its remarkable cauliflower productivity (31 t/ha) surpassing both the national average productivity (19.2 t/ha) and the productivity of all other states. The study employed a multistage sampling design to select a total sample of 160 cauliflower growers. Findings reveals that majority of the farmers (63%) in study area have embraced unique and non-conventional cauliflower hybrids like Girja, Maharani, Garima, White Excel and other hybrids. These particular hybrids have not received any endorsement from the State Agriculture University (SKUAST-J) and not been documented elsewhere and surprisingly such hybrids exhibited remarkable average productivity of 33.17 t/ha in study area as well as elite growth performance, high disease resistance, high frost resistance, etc, as compare to open pollinated variety which gives productivity of 20.93 t/ha. In addition to this, farmers were conscientious in applying critical production and protection inputs which significantly impacting productivity of cauliflower crop.

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**KEYWORDS:** Cauliflower, Productivity, Hybrids, Open pollinated, Multistage sampling design

**Introduction**

Agriculture is the primary occupation for rural residents across the country, with approximately 70 per-cent of the population directly or indirectly reliant on agriculture and related activities for their livelihoods (FAO, 2018). It stands as the most crucial human endeavor, vital for both physical sustenance and economic prosperity. Agriculture serves as the sole source of food, fibers and various other agricultural products. In the evolving agrarian landscape, there's a growing recognition of the pivotal role played by the horticultural sector in ensuring global livelihood security for farmers. This sector represents one of the fastest-growing segments within agriculture and allied sectors, contributing approximately 30 per-cent to its overall output (MoA, 2018). Among the diverse range of crops cultivated in the country, vegetables play a crucial role in India's food supply, forming an essential component of a balanced and nutritious diet. They contribute around 59.15 per-cent of the total horticultural output, underscoring the rapid expansion of the horticulture sector. This burgeoning sector plays a substantial role, contributing around 30 per-cent to India's agricultural GDP (MoA, 2018), highlighting its critical importance in the nation's economic landscape. Among farmers, vegetable cultivation holds significant importance as a source of income due to its shorter maturity cycle and higher productivity. This leads to increased employment opportunities on and off the farm, particularly benefiting smallholder farmers who dominate Indian agriculture, covering 33 per-cent of the land and comprising 78 per-cent of total holdings (Kundu & Mandal, 2020). In India, the area dedicated to vegetable cultivation has seen substantial growth, expanding from 5,593 thousand hectares in 1991-92 to 10,259 thousand hectares in 2017-18, with production increasing from 58,532 thousand metric tons (mt) to 184,394 thousand mt during the same period (MoA, 2018). Cauliflower (*Brassica oleracea* var. botrytis) stands out among major vegetables, contributing 4.70 per-cent to the country's vegetable production (National Horticulture Board, 2018). In India, cauliflower is cultivated across approximately 465 thousand hectares, yielding around 9,083 thousand mt, accounting for roughly 32.5 per-cent of global production (MoA, 2018). In Jammu and Kashmir (J&K), Union Territory of India, cauliflower cultivation covers 3.40 thousand hectares, with a total production of 105.40 thousand mt (MoA, 2018). Popular cauliflower varieties in the region include Pusa Katki and Pusa Deepali in plain areas, while Snowball is predominant in hilly and temperate regions. Varieties like Pusa Snowball-1, Pusa Snowball K-1, Pusa Snowball-16 and Giant Snowball are also common in the plain areas of J&K (Directorate of Agriculture, 2014). Analysis of data reveals that J&K (UT) boasts the highest average cauliflower productivity of 31 t/ha, surpassing both the national average (19.2 t/ha) and the average of all other states. Further investigation shows that the average productivity of cauliflower varieties recommended by State Agricultural University, SKUAST-J and other documented sources is approximately 19 t/ha, aligning closely with the national average. Given the exceptional productivity of cauliflower in the J&K in general and Jammu region in particular, the present study is conducted to identify the cultivation practices adopted by farmers which determine the causes behind the exceptional productivity of the cauliflower crop in Jammu region of Jammu and Kashmir (UT).

**Material and Methods**

The present study was conducted in Jammu district of Jammu region, Jammu and Kashmir (Union Territory) during 2020-2021, coinciding with the "International Year of Fruits and Vegetables". It utilized a descriptive research design and utilized a multistage sampling technique to establish the final sample. Firstly, Jammu district was purposively chosen due to its significant cauliflower cultivation area (775 ha) and production (16988 metric tonnes). Subsequently, the agricultural sub-division “Marh” was selected from four sub-divisions within Jammu district, based on its substantial cauliflower cultivation area (493 ha). Following this, a list of 500 cauliflower growers was compiled with the assistance of the Directorate of Agriculture, Jammu. From this list, 160 farmers cultivating cauliflower in at least 0.05 ha within the selected sub-division of Jammu district were randomly chosen to constitute the study's total sample size.

To achieve the study's objectives, a structured interview schedule containing open and closed-ended questions was devised for data collection via personal interviews. In addition, the primary and secondary data were collected from diverse government reports and online sources for this study. The primary data collected through personal interviews regarding to cauliflower productivity variables, spanning from sowing to harvest were systematically organized and classified within an Excel spreadsheet. This involved the calculation of frequency distribution, average means and standard deviations.

**Results and Discussion**

**1. Cauliflower hybrids and varieties grown by farmers:**

Sampled cauliflower growers in the study area cultivated various hybrids and open-pollinated varieties of the cauliflower crop, as shown in Table 1. The result depicts that about 74 per-cent of respondents were growing hybrids, namely the Girja hybrid which was grown by 54 per-cent of cauliflower growers followed by Maharani (15%), White Excel (14%), Garima (13%) and some other kind of hybrid (17%) whereas 37 per-cent of cauliflower growers were growing OP.

**Table 1: Distribution of respondents based on hybrids and open pollinated varieties (OP) of cauliflower adopted by cauliflower growers.**

|  |  |
| --- | --- |
| **Parameters\*** | **No. of farmers****(n=160)** |
| Respondents growing hybrids | 119 (74) |
| 1. Girja | 64 (54) |
| 2. Maharani | 18 (15) |
| 3. Garima | 15 (13) |
| 4. White Excel | 17 (14) |
| 5. Other hybrids | 20 (17) |
| Respondents growing OP (Un-descript) | 59 (37) |

\**Multiple Responses*

**2. Conventional and modern cauliflower cultivation practices implemented by farmers:**

The Table 2 represent the status of important critical production and protection cultivation practices adopted by sampled farmers in study area. The data revealed that, on an average, the cultivation area under cauliflower crop at comprehensive scale was 0.28 hectares and among these, cauliflower hybrids occupied larger area in comparison to the open pollinated varieties (OP) of cauliflower crop *i.e.,* 0.26 hectares and 0.23 hectares, respectively. Similarly, majority of the cauliflower growers at overall level sowed seeds in October and September as their foremost sowing month, which might contribute to the increase in the production of best quality curd in study area, as this finding is adequately supported by an experiment of (Thakur, 2014). As far as seed rate is concerned, overall cauliflower growers adopted 599.45 g/ha of seed rate which is slightly higher than recommendation by State Agriculture University ([[1]](#footnote-1)SKUAST-J) (Directorate of Extension, 2020) and among these, hybrid growers adopted seed rate of 429.58 g/ha which is as per recommendation of SAU (SKUAST-J) (Directorate of Extension, 2016), whereas, OP growers adopted high seed rate of 766.4 g/ha, this might be due to the fact that, OP growers used their own save seed, having somewhat low germination and cost than hybrid seed, which leads to excess usage of seed by the respondents. Only OP growers in study area adopted seed treatment method and majority of these used bio-stimulant Bavistin with an average dosage of 80.07 g/kg of seed and few of them used Trichoderma with an average dosage of 27 g/kg of seed. These bio-stimulant treatments improve plant resistances to biotic and abiotic stress and considered as sustainable tool for increasing yield of horticulture crops (Shahrajabian, 2021; Mola et al., 2023).

Regarding nutrient application, most cauliflower growers in the study area relied on FYM, urea and DAP to meet the crop’s nutrient needs. They applied an average quantity of 30.79 t/ha, 520 kg/ha and 245.1 kg/ha of FYM, urea and DAP, respectively. Some growers also used 114.7 kg/ha of MOP. Cauliflower hybrid growers were applying slightly higher doses of fertilizers, as compared to OP growers with 29.07 t/ha, 495.9 kg/ha, 222.5 kg/ha and 100.5 kg/ha of FYM, urea, DAP and MOP in hybrids. Recommended fertilizer dosage for cauliflower hybrids are 420 kg/ha, 220 kg/ha and 170 kg/ha for urea, DAP and MOP, respectively (The Directorate of Extension, 2016). The data indicates that hybrid growers in the study area are generally following recommended DAP doses, while slightly deviating in the case of urea and MOP. However, according to (The Directorate of Extension, 2020), overall cauliflower growers were applying more urea and DAP then necessary and slightly more MOP than recommended. This adoption pattern contributes to higher cauliflower productivity, as supported by an experiment of (Subedi et al., 2020), which founded that optimal nitrogen, phosphorus and potassium levels enhance yield and curd quality. Similar findings were observed by (Singh et al., 2015), confirming the positive impact of recommended as well as increasing N, P and K adoption level on cauliflower growth and productivity. In addition to these, for sustainably increasing the cauliflower curd yield, a desirable combination of nutrients should be implemented as Integrated Nutrient Management (INM) (Tarafder and Roy, 2023). Regarding weed management, weed infestation was slightly higher in fields of OP cauliflower growers (88%) compared to hybrid growers (81%). To combat the prevalent weeds *Cyperus rotundus* and *Phalaris minor,* majority of cauliflower growers employed herbicides like alachlor, metsulfuron methyl 20%WP, oxyfluorfen 23.5%EC and propaquizafop 10%EC, averaging 1.34 l/ha, 0.58 l/ha and 0.52 l/ha, respectively. Competitive weeds like these can cause significant yield losses, as shown by (Boyd et al., 2022), who reported a 35% cabbage yield reduction due to *Cyperus rotundus* infestation. Effective weed suppression with oxyfluorfen and alachlor contributed to increased cauliflower head yield and overall productivity, supported by studies conducted by (Mehmi et al., 2021; Qasem, 2007). As far as insect pests is concern, hybrid growers (34%) observed higher pest levels compared to OP growers (27%). The dominant pest, Diamondback Moth (DBM) was observed by majority of the cauliflower growers and is also as confirmed by (Ahmad & Ansari, 2010) and for protecting cauliflower crop from DBM, majority of the respondents applied pesticide chlorantraniliprole18.5 SC with an average quantity of 0.13 l/ha. This pesticide effectively reduced larval populations and minimized yield loss, in line with findings from (Patel & Patel, 2020). Disease management was practiced against Black rot, a prevalent issue in cauliflower crops, particularly among hybrid growers (11%) and OP growers (8%). The fungicide carbendazim 50%WP (1.5 kg/ha) was commonly used to control this disease, consistent with (Kahn et al.,2014). The study conducted by (Gill et al., 2020) also highlighted that over 50 per-cent of the participants noted the presence of weeds, insect-pest and diseases in cauliflower crop, but interestingly, farmers in study area, reported a comparatively lower incidence of these issues. The study indicates that farmers were conscientious in applying critical production inputs, ultimately impacting cauliflower crop productivity, echoing findings by (Rakesh et al., 2018; Yadav et al., 2012) albeit with nuances, that full adoption of crop production and protection technology is very important in achieving desired level of productivity.

The combined implementation of the aforementioned cauliflower crop production factors by growers in the study area leads to elevated cauliflower production and productivity, recorded at 86.91 quintals and 293.26 q/ha, respectively. Notably, hybrid cauliflower exhibited the highest productivity at 331.74 q/ha, surpassing the output of OP varieties at 209.32 q/ha.

**Table 2: Classification of respondents based on the cultivation practices followed by cauliflower farmers.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Hybrids****(119)** | **Open pollinated variety (59)** | **Overall****(178)** |
| **Average area (ha) ± S.D.** | 0.26 ± 0.28 | 0.23 ± 0.19 | 0.28 ± 0.29 |
| **Time of sowing\* (no. of farmers)** |
|  July | 0 | 2 (3) | 2 (1) |
|  August | 3 (2) | 11 (19) | 14 (8) |
|  September | 37 (31) | 24 (41) | 61 (34) |
|  October | 51 (43) | 17 (29) | 68 (38) |
|  November | 29 (24) | 3 (5) | 32 (18) |
|  December | 13 (11) | 2 (3) | 15 (8) |
|  January | 1 (1) | 0 | 1 (1) |
| **Average seed rate (g/ha) ±S.D.** | 429.58 ± 424.81 | 766.4 ± 690.94 | 599.45 ± 612.53 |
|  **Seed Treatment** |
| Bavistin (g/kg seed) ±S.D. | 0 | 80.07 ± 71.48 | 80.07 ± 71.48 |
| Trichoderma (g/kg seed) ± S.D. | 0 | 27 ± 9.89 | 27 ± 9.89 |
| Number of respondents applied **Farm Yard Manure (FYM)** | 115 (97) | 57 (97) | 172 (97) |
| Average quantity of applied FYM (t/ha) ± S.D. | 29.07 ± 14.48 | 25.39 ± 9.26  | 30.79 ± 16.13 |
| Number of respondents applied **urea as top dressing**  | 117 (98) | 57 (97) | 174 (98) |
| Average quantity applied as top dressing  | 495.9 ± 270 | 414.38 ± 190.52 | 520 ± 285.1 |
| Number of respondents applied **DAP as basal dose**  | 118 (99) | 55 (93) | 173 (97) |
| Average quantity of DAP (kg/ha) ± S.D. | 222.5 ± 133.4 | 217.82 ± 161.05 | 245.1 ± 162 |
| Number of respondents applied **MOP as basal dose**  | 73 (61) | 34 (58) | 107 (60) |
|  Average quantity of MOP (kg/ha) ± S.D. | 100.5 ± 67.16 | 104.71 ± 65.33 | 114.7 ± 91.01 |
|  **Weed Management** |
| Weeds observed (no. of farmers) | 97 (81) | 52 (88) | 149 (84) |
| Manual (no. of farmers) | 18 (19) | 21 (40) | 39 (26) |
| Chemical (no. of farmers) | 79 (81) | 31 (60) | 110 (74) |
|  Herbicide applied  |
| Alachlor 50%EC (litre/ha) ±S.D. | 1.20 ± 1.06 | 1.19± 0.71 | 1.34 ± 1.09 |
| Metsulfuron methyl 20%WP (l/ha) ±S.D. | 0.55 ± 0.37 | 0.48 ± 0.19 | 0.58 ± 0.41 |
| Other herbicide (Oxyfluorfen 23.5%EC, Propaquizafop 10%EC) (l/ha) ±S.D. | 0.58 ± 0.44 | 0.37 ± 0.21 | 0.52 ± 0.39 |
|  **Insect-Pest Management** |
| Insect-pest observed (no. of farmers) | 40 (34) | 16 (27) | 56 (31) |
| Chemicals applied (no. of farmers) | 34 (85) | 15 (94) | 49 (87) |
| Chlorpyriphos 50%+Cypermethrin 5 %EC (l/ha) ±S.D. | 0.19 ± 0.06 | 0.53± 0.34 | 0.43 ± 0.32 |
| Coragen (Chlorantranilliprol 18.5%SC) (l/ha) ±S.D. | 0.15 ± 0.07 | 0.1 ± 0 | 0.13 ± 0.06 |
| Phorate (kg/ha) ±S.D. | 3.08 ± 2.90 | 2 | 2.9 ± 2.6 |
| Thiamethoxam 25%WG (kg/ha) ±S.D. | 0.27 ± 0.11 | 0.27 ± 0.11 | 0.29 ± 0.11 |
| Dichlorvos 76%EC (l/ha) ±S.D. | 0.95 ± 0.57 | 0.2 | 0.8 ± 0.6 |
| Flubendiamide (l/ha) ±S.D. | 0.35 ± 0.20 | 0 | 0.35 ± 0.20 |
| \**Disease Management** |
| Disease observed (no. of farmers) | 7 (11) | 5 (8) | 12 (7) |
| Chemical Control (no. of farmers) | 6 (86) | 5 (100) | 11 (92) |
| Carbendazim 12%+Mancozeb 63%WP (kg/ha) ±S.D. | 0.53± 0.11 | 0.6 ± 0 | 0.7 ± 0.35 |
| Carbendazim 50% (kg/ha) ±S.D. | 1.17 ± 0.76 | 1.33 ± 0.58 | 1.5 ± 0.70 |
| Average total **production** (quantals)±S.D. | 92.69 ± 107.30  | 50.30 ± 51.47 | 86.91 ± 101.47 |
| Average **productivity** (q/ha) ±S.D. | 331.74 ± 112.88 | 209.32 ± 78.80 | 293.26 ± 119.07 |

\*Multiple responses

**Conclusion**

Cauliflower stands out as the primary vegetable cultivated by farmers in the Jammu district. Within this area, cauliflower hybrids are the dominant choice, surpassing open-pollinated (OP) varieties. Notably, a considerable number of farmers prefer exclusive and unique hybrids like Girja, Maharani, Garima, and White Excel, indicating a reliance on private sector hybrid seed distribution. These hybrids boast impressive traits such as high productivity, disease resistance, and frost tolerance, which outshine open-pollinated cauliflower varieties. Furthermore, farmers in this study demonstrate a commendable commitment to meeting essential input requirements, contributing to the remarkable performance of cauliflower. This integrated approach leads to exceptional cauliflower productivity in the study area, exceeding both the national average and that of other states. Farmers in Jammu and Kashmir (UT) opt for exclusive cauliflower hybrids not recommended by universities or documented elsewhere. These hybrids exhibit higher productivity compared to the national average of 19 t/ha. Farmers express satisfaction with the performance of these cauliflower hybrids and request universities and agricultural offices to release hybrid seeds. Agriculture offices should ensure the availability of high-performing hybrid seeds, as some farmers resort to purchasing from input dealers or private agencies due to the unavailability of preferred seeds from agriculture offices. Additionally, the government should provide storage facilities for cauliflower growers to avoid immediate sales after harvest. Farmers need to be informed about various agricultural technologies like contract farming and organic farming. Highlighting success stories of farmers who have adopted high-yielding hybrid seeds in the news can motivate others to follow suit, thus contributing to the economy of Jammu and Kashmir as well as the national economy. Furthermore, farmers should be educated about different information and communication technology (ICT) tools to access market information, pricing trends, efficient marketing channels, and expert advice from scientists, thereby empowering them to make informed decisions from the comfort of their homes.

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1.

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