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# Assessment of knowledge and adoption pattern of post-harvest management practices by Maharashtrian onion farmers

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ABSTRACT

Horticulture sector in India is witnessing a continuous expansion. Simultaneously, a significant amount of produce is lost due to the post-harvest losses. Studies report a wide gap between the rate of technology development by research institutes and the uptake of the same by grass-root farmers. This can be attributed to the lack of information or in-depth knowledge about such technologies. The present study has examined the current status of onion farmers' knowledge and the level of adoption of the recommended pre-harvest and post-harvest management practices. The study was carried out during 2020 in purposively selected Junnar and Dindori blocks of Pune and Nashik districts, Maharashtra respectively. The study revealed that 40% of the respondents clustered under the high knowledge category and 41.67% respondents displayed medium level of adoption. Majority of the respondents were knowledgeable and adopted practices like harvesting at the optimum time and correct stage of maturity, proper handling, curing, sorting, grading, and packaging at field level. However, they overlooked the adoption of certain essential practices, for instance selection of suitable cultivars, nursery management, application of bio-fertilizers, bio-fungicides, market intelligence and secondary processing. The emphasis should be to devise a mix of appropriate extension strategies to narrow down the knowledge-practice gap faced by the onion farmers.

**Keywords:** Adoption, Curing, Grading, Knowledge, Post-harvest losses

India stands second in world production after China, the total horticultural production being 320.48 mt for 2019-20 (Press Information Bureau 2020). The area under onion in India is 1.29 mha with a production of 23.262 mt (DAC&FW 2019). It has gained importance as a cash crop over the years, rather than a vegetable crop, owing to its huge share in exports. Maharashtra is the largest onion producer with 33% of the country's total production, largely from Nashik, Ahmednagar, Pune and Satara. Even though India has made considerable strides on the production side, a huge portion of the fruits and vegetables is lost. Post-harvest losses may occur at any point from the stage of initial harvest through assembly (packaging, transport, loading-unloading, storage) and distribution to the final consumer. Gajanana *et al.* (2011) reported 10.43% post-harvest losses in onion (Bellary Red) at the field and 2.12% at retailers' level in Karnataka. Nanda *et al.* (2010) reported 7.51% overall post-harvest losses in onion. Out of this, the total losses in farm operations were 5.17%, followed by 2.34% storage losses. These post-harvest losses are not only a clear wastage of food, but also represent an equivalent waste of human efforts, farm inputs, livelihoods, investments and scarce resources such as water. So, there is an urgent need to reduce the production losses. Poor farm management and lack of suitable post-harvest management practices contributes to the high losses. At the grass roots level, there is a huge mismatch between the rate of production of the agricultural technologies and the adoption of the same by small scale farmers. The losses can be minimised by having proper knowledge and timely adoption of the various recommended practices. Considering the previous works which identified the knowledge level as a determinant in the post-harvest losses at the farm level, the present study was undertaken to assess the knowledge level and adoption pattern of the recommended PHM practices by the onion growers in the study location, so as to devise suitable strategies in future to reduce the Knowledge- Practice gap.

## MATERIALS AND METHODS

Two major onion producing districts Pune and Nashik of Maharashtra state were purposively selected to collect the primary data on onion growers' knowledge and adoption status of pre-harvest and post-harvest management practices

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(2020). The blocks Junnar from the district Pune and Dindori from the district Nashik were purposively selected. The villages, viz. Narayangaon and Agar from Junnar block and Janori and Lakhamapur villages from Dindori block were selected through random sampling method. Fifteen farmers from each village, summing to 60 were chosen from these four villages through random selection. The data were collected with the help of a well-structured and pre-tested interview schedule comprising the items for assessment of knowledge level and adoption of pre and post-harvest management practices recommended for onion. The statistical measures like frequency, percentage, and cumulative square root frequency method were used to analyse the data to draw tangible inferences.

## RESULTS AND DISCUSSION

*Knowledge and adoption level of the onion growers*: The knowledge level of the onion farmers was measured with the help of the knowledge test. The test consisted of items selected based on expert opinion (relevancy test), discrimination index value, and difficulty index value (Table 1). The post-harvest quality of the produce was largely affected by the pre-harvest factors like choice of cultivars, nursery management, nutrient management, pest and disease management, proper irrigation regime, etc. Improved onion varieties have been developed by various institutes like Directorate of Onion and Garlic Research (DOGR), Indian Agricultural Research Institute (IARI), Indian Institute of Horticultural Research (IIHR), National Horticultural Research and Development Foundation (NHRDF), and State Agricultural Universities (SAUs) incorporating traits like season specificity, disease resistance, good storability, etc. For example, Bhima Shubra, Bhima Super, Bhima Dark Red are the *kharif* specific varieties whereas Bhima Shakti, Bhima Kiran, Bhima Shweta can be grown in the *rabi* (ICAR 2020). Light red onion varieties such as N-2-4-1, Bhima Kiran, Bhima Shakti, Arka Niketan, and Agrifound Light Red have comparatively higher storability than the dark red, white, and yellow varieties (Choudhary 2018). The study reported that only 16.6% of the farmers were aware of the existence of such varieties and half of them adopted those in their fields. Others complained about the non-availability of the cultivars on time. They mainly grew a local variety called Puna Fursungi.

Table 1 Distribution of onion farmers according to their level of knowledge, adoption and knowledge-practice gap (n = 60)

| Statement | Knowledge | Adoption | K-P Gap | Knowledge (%) | Adoption (%) | K-P Gap (%) |
|---|---|---|---|---|---|---|
| Choose season-specific cultivars with disease resistance and better storability | 10 | 5 | 5 | 16.6 | 8.3 | 8.3 |
| Raised bed (not flat beds) for nursery | 20 | 8 | 12 | 33.2 | 13.28 | 19.92 |
| Broad bed furrow (BBF) for main field | 22 | 8 | 14 | 36.52 | 13.28 | 23.24 |
| Balanced nutrient application of NPK+ FYM | 60 | 35 | 25 | 99.6 | 58.1 | 41.5 |
| Use of biofertilizer | 30 | 5 | 25 | 49.8 | 8.3 | 41.5 |
| Application of Sulphur and 0.5% Zinc | 50 | 50 | 0 | 83 | 83 | 0 |
| Seed treatment with Thiram or Captan 0.3% | 50 | 26 | 24 | 83 | 43.16 | 39.84 |
| Application of bio-fungicide | 25 | 5 | 20 | 41.5 | 8.3 | 33.2 |
| Proper irrigation regime (Drip or sprinkler) | 40 | 14 | 26 | 66.4 | 23.24 | 43.16 |
| Frequent light irrigation and withhold irrigation 2-3 weeks before harvesting | 20 | 20 | 0 | 33.2 | 33.2 | 0 |
| Proper handling to avoid mechanical injuries during harvesting, weeding | 60 | 45 | 15 | 99.6 | 74.7 | 24.9 |
| Harvest in morning hours (at coolest period) | 60 | 60 | 0 | 99.6 | 99.6 | 0 |
| Harvest at optimum maturity (one week after 50% top fall) | 60 | 50 | 10 | 99.6 | 83 | 16.6 |
| 2-3 days field curing of harvested bulbs | 60 | 60 | 0 | 99.6 | 99.6 | 0 |
| Remove tops with 2-3 cm stalk above bulbs | 45 | 45 | 0 | 74.7 | 74.7 | 0 |
| Shade curing for 10-12 days at optimum temperature and adequate ventilation | 40 | 17 | 23 | 66.4 | 28.22 | 38.18 |
| Sorting of the bulbs | 60 | 55 | 5 | 99.6 | 91.3 | 8.3 |
| Grading based on size and market | 60 | 40 | 20 | 99.6 | 66.4 | 33.2 |
| Bottom and side ventilated, well designed, leak-proof storage structures | 46 | 14 | 32 | 76.36 | 23.24 | 53.12 |
| Packaging in jute bags, gunny bags, plastic netted bags | 60 | 60 | 0 | 99.6 | 99.6 | 0 |
| Market intelligence system | 33 | 10 | 23 | 54.78 | 16.6 | 38.18 |
| Secondary processing to utilise surplus stock and get higher prices | 33 | 0 | 33 | 54.78 | 0 | 54.78 |

For raising nursery, raised beds of 10-15 cm height, 1 m width, and length, with a distance of at least 30 cm between the beds were recommended. But this recommendation was followed by a meagre 13.28% of the respondents. Most farmers in the study area practised flat-bed nursery system. But this practice posed problems like drainage of excess water and washing away of the seeds. Although 50 out of 60 farmers were aware of the need for seed treatment with Thiram/Captan @ 2 g/kg seeds to prevent damping off; the farmers did not follow it, citing the unawareness about the importance of pre-sowing seed treatment and unaffordability of the chemicals. The study reported that 41.5% farmers were aware about the application of bio-fungicide *Trichoderma viride* to manage damping off and raising healthy seedlings, but only 8.3% of them adopted it, criticising the unavailability of the same. For the main field, broad bed furrows (BBF) of 15 cm height, 120 cm top width, and 45 cm furrow are recommended to achieve proper spacing, improved aeration, and population density. A considerable 36.52% of the farmers knew about the BBF method, however 13.28% followed the method. Mostly, they followed flatbeds of size 1.5-2 m width and 4-6 m length. This created the problem of water-logging, which favours Anthracnose disease.

Onion needs frequent light irrigation to maintain optimum soil moisture and ensure proper bulb development. Irrigation is stopped when the crop attains maturity, i.e. 10-15 days before harvest. The study recorded a segment of 66% farmers aware of water-efficient methods of drip and sprinkler irrigation but adopted only by one-third of the respondents. Majority of the farmers preferred flood irrigation considering the hassle-free nature and relatively lower costs of the process. Only 23.24% of the farmers have adopted micro-sprinkler irrigation. This preferred selection of the flood irrigation method led to the splitting of the outer scales and formation of bolters in many instances where a dry spell was followed after the excess irrigation.

Though cent percent famers possessed knowledge of the need for balanced nutrient (NPK) application along with well decomposed farmyard manure (FYM), around 58% of the respondents adopted it in their fields. This share of the respondents was following the NPK requirements of 110 kg nitrogen, 40 kg phosphorus and 60 kg potash and organic manure equivalent to 75 kg N (present in 15 t/ha of FYM). However, 25 out of 60 defaulted in applying the FYM, primarily because of the low availability of organic manure, due to low cattle population of the area. A fair share of the farmers (83%) was aware of the importance of sulphur and zinc for bulb yield. The farmers applied zinc through foliar sprays at 45 and 60 DAT for improving the bulb quality. Application of sulphur was recommended in permissible doses for yield enhancement and imparting pungency to the onion bulbs. However, it was observed that the farmers were rampantly applying sulphur for rapidly increasing the bulb size, in order to benefit from the prevailing high market rates. Indiscriminate and uncontrolled use of sulphur hampered the development of inner layers in tubers. Bio-fertilizers- *Azospirillum* and phosphorus solubilising bacteria @ 5 kg/ha are recommended for onion crop. Though almost half of the segment was aware of the bio-fertilizer use and its application, only 5 out of total applied bio-fertilizers. Many found the use of bio-fertilizers complicated and cumbersome, whereas others were uninformed how to access the bio-fertilizers.

The farmers had knowledge of the optimum time and stage of harvesting, and specific aspects of the post-harvest handling (like field curing, sorting, grading, packaging). In practice, the farmers harvested the crop in cooler period of the day like morning. The harvesting is recommended to start after 50% tops fall. Though farmers were willing to follow the correct practices, but in many cases, some delay was reported because of the unavailability of labour. Harvesting was mainly done through manual uprooting, a handful number of farmers used hand hoe for digging the bulbs to avoid mechanical injuries during harvesting. All the farmers reported that they were following the practice of field curing of the harvested bulbs for 2–3 days till the foliage turns yellow and the neck becomes thin. This made the bulbs firm, dry and increased their shelf-life. Though all the farmers cut the tops above the bulbs, 75% of the farmers actually knew the scientific method and followed the specifications that the tops should be removed leaving 2–2.5 cm stalk above the bulbs. The rest of the farmers cut the tops too close to the bulbs, which resulted in cuts or openings that proved as an entry point for various microbial infections. As per the recommended practices, the bulbs should be shade cured for 10-12 days for better storage after the stalk removal. But in the study area, it was noted that many of the farmers ignored this step with the perception that field curing was sufficient. Only a meagre proportion of the respondents (around 28.22%) were found to follow the practice of shade curing. A significant proportion (91.3%) of the respondents adopted the sorting procedure to pick and discard the rotten, split, thick-necked, bolted, injured, misshapen small bulbs. Although aware of the grading practice, not everyone followed it. Out of the total, 66.4% graded the produce, based on size or market to which it is to be sent (for example, big sized bulbs to Delhi, medium-sized to Kolkata, Patna, and small-sized to North East). The farmers packaged the produce in Jute (hessian) bags, gunny bags, plastic netted bags of 50 kg weight. Almost three-fourth of the farmers immediately sold the produce in the market and 23.24% stored the produce for marketing at a later period. The produce was stored in well designed, leak-proof storage structures, which were bottom and side ventilated, with temperature maintained at 25–30$^0$C or 0–5$^0$C and 60–65% relative humidity.

Most of the farmers were unequipped with the market intelligence system (Demand, Arrival, Market price) to make better and informed choices of where, when, and at what price to sell the produce. This reduced their bargaining power and thus they had to sell their produce at the prices decided by the traders. None of the respondent farmers were into secondary processing of onion into value-added

products like dehydrated onion, onion powder, onion flakes, onion vinegar, onion chutney, onion pickle, onion oil, etc. However, 33% of the respondents were aware of the concept of secondary processing. This finding was similar to the results reported by Ghanghas *et al.* (2017) that the majority of the vegetable growers in Haryana were not storing and processing the produce. The findings were in line with the results reported by Kader (2005) and Azad (2013).

The distribution of the respondents based on their knowledge and adoption level has been done using the cumulative square root frequency method (Table 2). Results indicate that out of the total sample, 40% of the respondents had high knowledge, 35% had medium knowledge and 25% had low knowledge. It can be thus inferred that the maximum of the respondents in the study location had medium to high level of knowledge about the various pre-harvest and post-harvest handling practices in onion. Also, the results confirmed to the findings of Nain and Bhagat (2005), Ravikumar *et al.* (2010), Nain and Chandel (2013), and Azad (2013) where it was reported that the majority of the respondents had a medium level of knowledge regarding horticultural practices. The results shared similarity with the findings of Sunil (2004) that majority of the tomato growers (49.17%) in Belgaum district of Karnataka belonged to the medium knowledge level category because of the lack of guidance about improved post-harvest technology practices.

Also, it can be inferred (Table 2) that 26.67, 45.01, and 28.32% of the respondents fall under the low, medium, and high level of practice categories respectively. Majority of the respondents displayed medium level of adoption of the recommended management practices for onion crop. The findings are in agreement with the results of Ghanghas *et al.* (2017) who reported that the majority of the vegetable growers of Haryana (51.7%) belonged to the 'moderate' adopter category followed by 35.8% and 12.5% in high and low categories of adoption of post-harvest management practices respectively. The findings were in line with the results reported by Shankar (2016) that the majority of onion growers in Khed tehsil of Pune district had medium level of knowledge about post-harvest management practices of

Table 2 Stratification of onion farmers according to their knowledge and adoption level (n = 60)

| Knowledge level | | | | | | |
|---|---|---|---|---|---|---|
| Value | Frequency | % | Square root frequency | Cumulative square root frequency | Range | Frequency (%) |
| 9 | 3 | 5.00 | 1.73 | 1.73 | Low (<8.57) | 15 (25) |
| 10 | 2 | 3.33 | 1.41 | 3.15 | | |
| 12 | 4 | 6.67 | 2.00 | 5.15 | | |
| 15 | 6 | 10.00 | 2.45 | 7.60 | | |
| 16 | 4 | 6.67 | 2.00 | 9.60 | Medium (8.57-17.14) | 21 (35) |
| 17 | 9 | 15.00 | 3.00 | 12.60 | | |
| 18 | 8 | 13.33 | 2.83 | 15.42 | | |
| 19 | 9 | 15.00 | 3.00 | 18.42 | High (>17.14) | 24 (40) |
| 20 | 8 | 13.33 | 2.83 | 21.25 | | |
| 21 | 3 | 5.00 | 1.73 | 22.98 | | |
| 22 | 3 | 5.00 | 1.73 | 24.72 | | |
| 23 | 1 | 1.67 | 1.00 | 25.72 | | |
| | 60 | 100.00 | 7.75 | | | |
| *Adoption level* | | | | | | |
| 6 | 3 | 5.00 | 1.73 | 1.73 | Low (<8.62) | 16 (26.67) |
| 7 | 7 | 11.67 | 2.65 | 4.38 | | |
| 8 | 6 | 10.00 | 2.45 | 6.83 | | |
| 9 | 7 | 11.67 | 2.65 | 9.47 | Medium (8.62-17.25) | 27 (45.01) |
| 10 | 10 | 16.67 | 3.16 | 12.64 | | |
| 11 | 7 | 11.67 | 2.65 | 15.28 | | |
| 12 | 3 | 5.00 | 1.73 | 17.01 | | |
| 13 | 1 | 1.67 | 1.00 | 18.01 | High (>17.25) | 17 (28.32) |
| 14 | 6 | 10.00 | 2.45 | 20.46 | | |
| 15 | 4 | 6.67 | 2.00 | 22.46 | | |
| 16 | 4 | 6.67 | 2.00 | 24.46 | | |
| 17 | 2 | 3.33 | 1.41 | 25.88 | | |
| | 60 | 100.00 | 7.75 | | | |

onion, viz. harvesting, curing, grading, and storage; and portrayed medium level of adoption of these practices. Meena *et al.* (2005) found that 51.33% of cabbage farmers belonged to the medium adoption group due to the high cost of inputs and uncertainty in market returns. The study shows that many farmers failed to adopt practices like selection of suitable cultivars, nursery management, application of biofertilizers, bio-fungicides, market intelligence, and secondary processing. Thus, there is an urgent need for concerted efforts by the state department of agriculture, research institutes, and state agricultural universities to lower the knowledge-practice gap amongst farmers by devising a careful mix of activities like meetings, discussions, mass media, exposure visits, demonstrations, etc. The state government needs to proactively intervene by providing regular training, essential inputs and credit at cheap prices to the farmers, creating state-of-the-art infrastructural facilities to undertake primary and secondary processing of the agricultural produce, forging market linkages.

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