SAFFRON – A LEGENDARY CROP OF KASHMIR HIMALAYA

Afifa S. Kamili, F.A. Nehvi* and A.R.Trag
Directorate of Research Sher-e-Kashmir University of Agricultural, Sciences & Technology of Kashmir, Shalimar Campus, J & K, 191121
*K. D. Research Station (SKUAST-K)

ABSTRACT

Saffron is the most expensive and prized spice and is regarded as a pivotal economy regulating factor for the development of Jammu and Kashmir State. It is one of the important commercial activities of rich heritage of Kashmir Valley. Kashmir enjoys the distinction of occupying the largest area (5707 ha) under saffron in the world. Despite this the crop has remained under exploited and unrefined. Once producing 173.82 q of saffron (out 5316 ha) earning foreign exchange worth Rs. 40 crores, the present production of 64.64 q is a matter of great concern. The area under saffron cultivation has declined primarily due to failure of precipitation during active growing season of saffron, non-application of nutrients to the hungry and thirsty saffron soils longer planting cycles as well as inadequate post harvest handling, processing and marketing. Ways and methods to over come various problems confronting the saffron production and productively have been highlighted.

Key words: Saffron, status, production, productivity, post harvest handling

INTRODUCTION

Amongst various agro based industries of the state of Jammu and Kashmir like sericulture, apiculture, kalazeera, red chillies, saffron (*Crocus satives* L) commonly known as kesar or golden condiment is most expensive and prized spice and is regarded as pivotal economy regulating factor for the development of the state. It is a legendary, high value and low volume cash crop used mainly as a source of secondary metabolites having incredible aromatic, medicinal and therapeutic values. Despite this, the crop has remained under exploited and unrefined (Kamili and Wani, 2006). The saffron is mainly rain fed crop requiring a cool and sunny climate and flourishes best at an altitude of 2140 m in slightly alkaline soils. (Ganai, 2001). Its plant is slow growing, perennial, herbaceous triploid, developing annually from buds on the another corm which acts as a dormant perennating storage corm. New daughter corms develop vegetatively through the swelling of basal internodes of main auxiliary shoots. Aerial portion consists of bunches of radical leaves (3-9 radical leaves/bunch) arising from buds present on the corm surface that subsequently produce at the base new daughter cormels (Fig. 1).

The most appropriate time of planting saffron corms is the second fortnight of August. Flowers arise along with the aerial shoots by mid October to early November (Fig. 2). During pre flowering period, 100-150 mm of rainfall is essential for growth and development of the plant. The commercial saffron is produced from the brilliant orange red stigma (20-30 mm long) along with approximately 35-50 mm portion style (Fig. 3). One kg. dried saffron is produced from 5.0-5.5 kg of fresh stigma and style which in turn are separated from nearly 45-50 kg of fresh flowers that contain about 1.13-1.50 lakh flowers (Anonymous, 2002).

ORIGIN

The word saffron is believed to have originated from Arabic word zia'ffron means yellow. Saffron belongs to family Irridaceae and genus *Crocus* of which about 80 species are known so far. It is believed to have originated from Greece, Asia minor and Persia spreading eastwards to Kashmir and China. Its cultivation in the world extends through 0 to 90°E longitude (Spain to Kashmir) and 30-45° Nlatitude (Persia to England). Today saffron is cultivated from the Eastern Mediterranean (Spain) to India (Kashmir).

Fig. 1. Germinating corms of Saffron

Saffron is unknown in wild state (Mathew, 1982,1999). It is a rain fed crop, grows well in cooler climates. Since 15th century numerous attempts have been made to introduce saffron into Germany, Switzerland Austria and England. However, all these saffron sites have been abandoned in view of its poor growth and development, with the exception of Mund, small Swiss village in Conton Wallis having an elevation of about 1200 m and producing a few kilograms of saffron per year.

Of the Western and central Asian areas, Iran is producing highest saffron now a days. Smaller amounts are also harvested in Turkey and India (Kashmir). Kashmir saffron has a high reputation but is hardly available outside India because of its low production and productivity.

INTERNATIONAL STATUS

Amongst various saffron producing countries, Iran, Spain and India are the largest producers (Table-1) accounting together for more than 95% of the world production which was approximately 204t during 2002. The distribution of saffron cultivation in the world reveals that more than 75 per cent of the area under its cultivation is confined to Iran contributing 160 t of saffron (2002) to the total world produce (204.60 t). Whereas, productivity of this crop is 5-8 kg ha^{-1} in Iran, Spain & Italy, it is only 2.8- 3.3 kg ha^{-1} in India (Kashmir) at present. World production of saffron at present is not enough to meet the global demand.

Table 1: Production and Productivity of Saffron in the World (2000)

	Iran	Spain	India	Greece	Azerbijan	Moracco	Italy
Production (tons)	160	29.15	6.46	4.3	3.7	1	0.24
Productivity (Kg/ha)	5	6.96	2.28	4.3	5.48	2	8.16

NATIONAL STATUS

Saffron is one of the important commercial activities of Indian agriculture and appears to be second largest industry after the fruit production in Jammu & Kashmir. Its cultivation dates back to 550 A.D. It is a legendary crop, an important component of culturally rich heritage of Kashmir and was used as an ingredient in Ayurvedic Medicines by the famous Kashmiri vaids (Vegbhatta and Sushtra).

Fig. 2. Saffron flowers in full bloom

Kashmir enjoys the distinction of occupying the largest area (5707 ha) under saffron in the world and has great potential for increasing its production and export to other countries. Once producing 173.82 q (Table 2,) of saffron out of 5316 ha which by conservative estimates of Rs.250 per tola led to earn foreign exchange worth Rs.40 crores, the present production of 64.64 q and productivity level of 2.28 kg ha^{-1} (2002) is far less when compared to other saffron grown countries of the world like Iran, Spain, Italy producing 5-6 kg ha^{-1} has been a matter of great concern. The area under saffron cultivation has also declined drastically 1998-2002 primarily due to failure of precipitation experienced during the active growing season of saffron and non-application of nutrients to soil which has resulted in enormous increase in the cost of seed corms thereby effecting the replantation rate in the conventional areas. In 2002 the area under saffron cultivation was hardly 2825 yielding 64.64 q. The other constraints which have cumulatively affected the saffron production and productivity are:

- Narrow genetic base because of complete sterile nature of corms.
- Lack of germplasm bank.
- Non-availability of high yielding corms
- Longer planting cycle of 10-15 years as compared to annual planting in Italy and 5-7 years cycle in Spain, Greece and Iran.
- Planting of non-graded corms at random as against space hand planting of only selected corms in an upright position in Italy and Spain.
- Incidence of corm rot disease.
- Non-application of nutrients.
- Absence of irrigation especially at critical stages of crop growth and development.
- Inadequate R&D support
- Lack of quality standards
- Inadequate post harvest handling, processing and marketing.

Jammu & Kashmir enjoys the monopoly in the cultivation of saffron in the sub-continent. Saffron is a rain fed crop and is cultivated around Padampore (now Pampore) on the elevated (Karewa) topography where almonds are also cultivated and there is a symbiotic relationship for saffron-almond cropping system. The saffron growing areas are severely to moderately eroded soils located at an altitude of 1600-2100 masl. The Karewas are reported to be of lacustrine origin of Pleistoctene and post- Pleistocene. These soils are placed in the alsi soils (shinde *et al* 1984) and their colour varies from brown to yellowish brown (Wani, 1994), besides being slightly alkaline in nature. The organic carbon, available nitrogen and phosphorus of these soils are low to medium whereas available potassium is medium to high (Ganai, 2001). The main areas of saffron cultivation are Zeewan, Balhama, Khunamu, Yachnambal (Srinagar) Khrew, Ludoo, Dussu, Konibal, Chandaha, Namblabal, Barsu, Lethipora, Sambora, Waantipora, Nagam, Sarwin, Hapthnar, Kakewring, Charar-e-Sharief and Kishtwar (Doda). 78.91 per cent of the total area under saffron cultivation is in the district Pulwama, followed by district Budgam

(12.27%), Srinagar (7.32%) and Doda (1.5%). More than 10000 farm families of 226 villages are associated with the cultivation of this crop, directly and indirectly and nearly 85 per cent families associated with its cultivation are categorized into small and marginal farmers, living below the poverty line. Most of the cultural and post harvest operations are primarily done by farm women which contribute 65 to 70 per cent of total labour component.

Table 2: Area, production and productivity of saffron in Jammu & Kashmir

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Area (ha)	4496	4496	4496	5707	5316	4416	3997	2831	-2713	2825
Production (q)	130.65	134.25	141.8	159.52	173.82	128.8	75.5	35.91	2.59	64.64
Productivity (Kg/ha)	2.91	2.99	3.14	2.80	3.40	3.13	1.89	1.27	0.095	2.28

Source: *Kamili and Wani 2006 (Research priority setting in saffron).*

This decreasing trend in the area of cultivation as well as in production and productivity of saffron is posing serious threat to the sustainability of saffron crop in Kashmir. To overcome, this problem cultivation of saffron based on scientific technological know how is required to be adopted on war footing.

CHEMICAL COMPOSITION OF SAFFRON

The commercial saffron contains water, protein, total N free extract, starch and sugars, fixed oil, volatile oil, crude fiber, ash, crocin and traces of potassium, phosphorous and boron (Table- 3).

Table 3: Chemical composition of saffron

Constituent	Percentage
Water	14.5-15.5
Protein	12.5-13.5
Total N free extract	54.5-57.5
Starch and Sugar	12.0-13.5
Essential oils	4.7-8.5
Valuable crude fibre	4.0-5.0
Ash	4.0-4.5
Crocin	13.5-15.0%
Potassium, phosphorus & boron	In traces

Source: *Kamili and Wani 2006 (Research priority setting in saffron)*

The yellow pigment is crocin (glycocides) comprising of alpha, beta and gamma compounds. The aroma of the pigment is released on heating through enzymatic hydrolysis of picrocrocin into safranil.

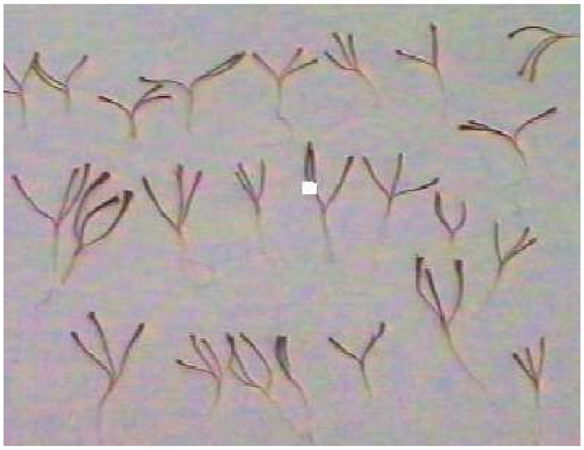

Fig. 3. Saffron Pistils

RESEARCH STRATEGIES TO IMPROVE PRODUCTION & PRODUCTIVITY IN SAFFRON

With a view to address the problems of low production and productivity of saffron in J&K state, attention of planners, scientists, administrators and policy makers was invited and a World Bank aided Project was approved under NATP (ICAR) for SKUAST-K which focused on the following main objectives.

Evaluation of germplasm

Saffron, a cormose triploid geophyte, is unknown in wild state. Failure to produce seeds because of triploidy and complete sterility has been a serious cause to bring variability in the population of the crop. Besides, the absence of germplasm bank and lack of high yielding saffron clones are major constraints of low productivity. Natural population of saffron has been seen to have some variability due to natural mutations and selections 47 sub-populations identified after evaluating 500 natural populations of saffron (Nehvi, 2004) showed yield superiority of 26.7 per cent (Table-4) and are under propagation for multiplication and subsequent release of high yielding corms for commercial exploitation.

Table 4: Performance of selected sub-populations of saffron

Population	Fresh flower weight (g)	Fresh pistil weight (g)	Dry pistil weight (g)	Stigma length (cm)	Style length (cm)	Pistil length (cm)
Superior Sub-population	0.359	0.036	0.0071	2.6	2.3	4.9
Natural Sub-population	0.274	0.018	0.0056	2.5	2.0	4.5

Source: *NATP report on saffron (SKUAST-K)*

Production Technology

i) Development of quality planting material

Recent analysis of saffron soils have indicated that these are hungry and more or less thirsty and are deficient in nutrient and organic matter. Application of FYM @ 250 qha^{-1} in combination with planting of corms weighing above 10 g at a density of 5 lac corms ha^{-1} under shorter planting cycles (3 to 4 years) as compared to longer planting cycles (10 to 15 years) commences in faster production of daughter cormels with an increased proportion of the flowering producing daughter cormels, and increased size and weight of corms (Table-5,6 &7). In addition, seed rate @ 70 q ha^{-1} under shorter planting cycles (3-4 years) produce higher saffron and corm yield.

Table 5: Effect of FYM, corm size and planting density on development of saffron

Treatment	Average cormel weight (g)	Number of cormels/corm
FYM=(250 q ha-^{1}) +5 lakh corms/ha + >15.0g corm wt.	10.46	7.24
FYM=(0) +5 lakh corms/ha + <10 g corm wt.	3.58	2.25
FYM= (0) +5 lakh corms /ha + 10-15g corm wt.	6.71	3.22
FYM=(0) +5 lakh corms /ha +>15g corm wt.	9.0	6.05

Source: *NATP report on saffron (SKUAST-K)*

Table 6: Effect of FYM, corm size and planting density on corm yield

Treatments	Number of cormels/m^2		Corm yield q/ha	
	Annual	Bi-annual	Annual	Bi-annual
FYM (250) q ha-^{1}) +5 lakh corms /ha +>15g corm wt.	125	173	97.38	154.2
FYM (0) +5 lakh corms q/ha +<10g corm wt.	71	123	75.32	83.0
FYM (0) q/ha)+5 lakh corms q/ha +10-15g corm wt.	78	143	80.50	94.0
FYM (0) +5 lakh corms q/ha+>15g corm wt.	88	153	90.0	104.21

Source: *NATP report on saffron (SKUAST-K)*

Table 7: Effect of seed rate and planting cycle on corm and saffron yield

Seed rate (q/ha)	Corm yield (g/ha)		Saffron yield (g/ha)		
	Annual	Bi-annual	Annual	Bi-nnual	Pluri annual
70	45.66	160.10	930	3780	4840
100	58.13	138.60	1480	2810	3280
130	66.14	128.56	1590	2750	3420

Source: *NATP report on saffron (SKUAST-K)*

ii) *Enhancement in yield*

FYM @ 175q ha^{-1} in combination with inorganic fertilizers @ 30:20:15 kg ha^{-1} ($N:P_2 0_5:K_2 0$) results in higher corm and saffron yield, (Table 8) besides improving the crocin content (Table-9)

Table 8: Effect of fertility levels on corm and saffron yield

Treatment	Corm yield/ha (q)		Saffron yield over 3 years (g ha^{-1})		Pluriannual
	Annual	Biannual	Annual	Biannual	
Organic 175 q ha^{-1}	69.10	119.72	1625.0	3750	4880
Inorganic 30:20:15	59.60	108.66	1411.67	3253.33	4220
Organic + Inorganic	69.96	121.25	1660.00	3800.00	4900
Control	50.81	89.75	1015.00	2360.00	3300

Source: *NATP report on saffron (SKUAST-K)*

Table 9: Effect of fertility levels on crocin content

Treatment	Crocin %
Organic (175q ha^{-1})	11.134
Inorganic (30:20:15)	11.256
Organic+Inorganic	12.349
Control	10.791

Disease management

In predominant saffron belt of Kashmir (Pampore), the incidence of major pathological disease (corm rot) in saffron ranges from 11.6-21.6 leading to reduction in corm and saffron yield. Duration in the increase of crop cycles have been observed to increase the disease incidence possibility due to higher built up and spread of inoculum over the years.

Two fungal cultures *Fusarium monliforme* var Intermedium Naish and Laggett and a basidiomycetous fungi have been seen responsible for cause of corm rot in saffron (Gani, 2001). Injury to corms has been seen to play significant role in spreading the disease cultivation of saffron under shorter planting cycles (3-4 years) and planting of healthy corms free from rot, lesions/injuries is the ideal cultural management practice. Besides, treatment of healthy corms with copper oxychloride 50 WP @0.05% or Captan 50WP @ 0.20% or Mancozeb 75 WP @ 0.3% + Carbendazim 50 WP @ 0.1% has been found effective in controlling the disease, (Table-10).

Table 10: Corm rot management in saffron

Treatment	Germination (%)	Corm rot (%)	Number of flowers/ha	Saffron yield (g/ha)	(%) increase
Mancozeb 75 WP @ 0.3% + Carbendazim 50 WP@0.1%	97.6	Nil	2548.57	1560	85.49
Control	42.0	13.65	142230	841	-

Sourc : *NATP report on saffron (SKUAST-K)*

Water requirement for saffron

In Kashmir valley saffron cultivation is exclusively rain fed and scarce precipitation especially during the critical stages of its development has far reaching implications on the productivity of crop. For accelerated growth of roots and floral primodia, saffron requires 10 irrigations @ 70m^3 /ha at an interval of 7 days (Nehvi, 2004) i.e; 25th August to 15th October (Sprouting stage) followed by 3 irrigations at an interval of 7 days from 8th Nov- 30th Nov. (Post flowering stage) This results in more activation of buds, increased number of flowers/hectare, maximum saffron recovery (2186 g/ha) (Table-11 & 12).

Table 11: Irrigation schedule of saffron

Stage	Month	No. of weeks	Quantity of water Required/ week @ 700 m^3/ha
Sprouting	August 25-31	1	70
Sprouting	Sept. 1-30	4	280
Sprouting	Oct. 1-15	2	140
	Total A	**7**	**490**
Post flowering	Nov. 8-30	3	210
	Total (A+B)	**10**	**700**

Source: *NATP report on saffron (SKUAST-K)*

Table 12: Impact of pre-sprouting irrigation on saffron yield

Qty. of water m3 (ha-1)	No. of flowers (ha-1)	Fresh flower weight ha-1	Fresh Pistil weight ha-1	Dry Pistil weight ha-1	Stigma length (cm)	Style length (cm)	Pistil length cm	% Increase
600	315714	108857	5682	1989	2.7	2.1	4.8	39.52
700	341571	118142	6339	2186	2.9	3.5	5.4	53.54
Control	254571	75857	4327	1426	2.6	2.3	4.9	

Source: *NATP report on saffron (SKUAST-K)*

Drying protocol for saffron

In Kashmir Valley and other hilly area, proper drying of agro products like silk cocoons, kalazeera, chillies, saffron is difficult due to availability of low temperature. Thus, drying takes larger time which results in quality deterioration as well as contamination by insects and pathogens. In order to overcome this problem, solar hot air dryers have been devised with the help of which saffron drying has become possible in 4-6 hours without bringing any change in pigment concentration (Table -13). Even low cost saffron drier has been developed (Kamili and Nehvi, 2004) for the economic benefit of the farmers and direct public use (Fig. 4), the cost of which does not exceed Rs.2750 per unit. It has shown excellent results by drying the saffron in just

 ISSN 0973-7502

3-4 hours and maintaining the crocin content up to 13.5% (Table 13). The farmers expressed high acceptability and satisfaction to this low cost saffron drier technology during its demonstration in the saffron belt area (Pampore, Kashmir) during 2004-05. Besides, pigment concentration remains very close to that found in fresh saffron (13-14% on dry matter basis) by the use of low cost saffron drier. This has also helped in increasing the export value of saffron.

Fig. 4. Demonstration of low cost saffron drier

Table 13: Saffron drying through different driers

Drier	Drying time (hours)	Fresh saffron capacity (g)	Crocin% in stigma	Life of equipment (years)	Cost of equipment (Rs.)
Hot air drier	4-6	12000	13.6	5	15000
Solar drier					
i. Heavy duty solar drier	5-6	315	13.0	5	6500
ii. Low cost solar drier	3-4	2175	13.5	20	
Traditional sun drying	27-53	-	-	-	Labour involvement

Source: *Low cost solar drier in saffron, Kamili & Nehvi 2005* ; *NATP report on saffron (SKUAST-K)*

Grading, marketing, export and trade mechanism of saffron in Jammu & Kashmir

Saffron is one of the most important foreign exchange earners among various spices of India. Because of consumers preference for quality, grading on scientific lines has assumed significant. Prize of saffron is also decided by the physical appearance of the product, colour and percentage of floral wastes and foreign matter. Scientifically, 3 grades of saffron viz; Moongra (special), Lacha (standard) and Guchi (Guchi grade standard) (Table-14) are marketed in Jammu and Kashmir based on color, floral waste content and foreign matter recognized by ISI. The lacha saffron yields Moongra when style portion is removed from it through sieving. In Kishtwar Guchi grade (stigma + style) is prepared at the time of trimming of flowers. Each Guchi is made from 120-150 flowers fetching very good price.

Table 14: Different grades of commercial saffron as per ISI standards

Commercial grade	ISI grade	Color	Floral wastage%	Foreign matter %
Mongra	Special	Deep Red	5.0 (50g/kg)	0.5(5g/kg)
Lacha	Standard	Light reddish	10.0 (100g/kg)	1.0 (10g/kg)
Guchi	Grade standard	Bright red	-	-

Source: *Agriculture in Jammu and Kashmir, Masoodi M. Amin,2000*

However, in view of being expensive material, marketing is in the hands of private entrepreneurs and a long chain of middle men are involved in the market practice resulting in menace of adulteration. Adulterants include floral parts (other then stigma) of safflower mixed with genuine material as such or after being dyed, corn silk, fibers of shredded meat dyed with saffron water, fibrous roots of various grasses, coloured nylon fiber, florets of marigold and slender roots of willow. Besides, fats, oils, and glycerine are also sometimes used to increase the weight. It is also reported that low quality cheap saffron from Iran is mixed with pure saffron from Kashmir. This calls for strict quality control checks to meet the export quality standards.

In Kashmir Valley, the big saffron traders purchase the surplus saffron at relatively cheaper rates from the growers and middle men during the months of November to January primarily for hoarding. Thus growers facing shortage of facilities and finance and having no information about the supply and demand of saffron at terminal markets get exploited and incur huge losses. The good quality saffron by and large is adulterated by the middle men that affects the credibility and genuiness of Kashmir saffron at global level.

For the last many years, saffron from Iran is being sold in India besides Kashmir at the rate of Rs.25000 kg^{-1} (550 $) in contrary to Kashmir saffron being sold at Rs.40,000 kg^{-1} (885$) and is used mainly as adulterant. In order to make the saffron cultivation a remunerative activity and make it competitive at international market, it is imperative to regularize this trade by establishing village level saffron marketing societies either with the intervention of State Govt. or the Spices Board of India to eliminate the middle men to reflect the true market value of Saffron. Apart from this quality testing of saffron is required to be done before its sale or export as per ISI standards.

Benefit cost ratio of saffron production

Agriculture research has played a crucial role in food security and sustainable development. However, current food scenario warrants to concentrate on diversification of agriculture to make it more profitable, commercial and sustainable. Therefore, capitalizing on prized condiment crops like saffron is imperative so that these emerge as viable alternatives for rural income generation. Benefit - cost ratio of ISI graded saffron (Gucchi & Moongra) after hoarding for 6 months is given in Table-15.

Table 15: Benefit-Cost ratio of saffron after 3 years of corm planting

Year	Cost of cultivation (Rs.)	Returns for saffron (Rs)	Returns for corms (Rs.)	Total returns (Rs.)	Benefit (Rs.)	B.C. Ratio
Annual	3,59,400	60,000	-	60,000	-	-
Bi-annual	79,600	1,33,880	7,77,810	9,11,690	-	-
Pluri-annual	91,600	1,86,680	-	1,86,680	-	-
Total	5,30,600	3,80,560	7,77,810	11,58,370	6,27,770	1:1.8

Source: *NATP report on saffron (SKUAST-K)*

AREAS OF IMMEDIATE ATTENTION

The sustainability of saffron crop is the most vital aspect to improve the economy of growers and earn foreign exchange for the state. Therefore, immediate attention is required towards the following.

(i) Transfer of technology through methodical extension

Various awareness and extension programmes are required to be taken in hand to promote adoption of new technologies, and package of practices for increasing the production and enhancing the development of saffron.

(ii) Establishment of seed villages

In order to make available quality planting material (seed corm), farmers are required to be identified in a village and encouraged to ensure multiplication of corms strictly under seed certification enforcement.

(iii) Mass multiplication of corms through in-vitro techniques

Since development of improved seed corms through vegetative propagation takes many years of hard labour and selection trials to build up elite material, it is imperative to use micro propagation technique to make available quality planting material in shortest period (2-3 years) to meet the demand of seed corms.

(iv) Agri export zone

In order to improve the production, post harvest aspects, domestic and international market and to provide remunerative price to growers on sustainable basis there is need to declare the traditional saffron growing areas of Kashmir as Agri- Export Zone. Besides, Spices Board of India is required to open its office in Pampore (Kashmir) for promoting the trade and export of saffron.

(v) Value addition

Value added products need to be developed from saffron for the wider use of this spice.

(vi) Ban on import of saffron

In order to increase the production and export of saffron, there is need to impose ban on import of saffron. This will also help in avoiding adulteration of Kashmir saffron.

(vii) Marketing

Marketing of saffron through co-operative societies and other autonomous bodies need to be encouraged to eliminate the role of middlemen and keep check on quality.

(viii) Quality testing laboratory

Well equipped laboratory which could test the quality of saffron are required to be established in the vicinity of saffron growing areas.

ACKNOWLEDGEMENTS

Authors are thankful to the authorities of SKUAST-K for providing necessary facilities. Thanks are also due to World Bank for funding the project under NATP.

REFERENCES

Anonymous, 2002. Botany of Saffron (*Crocus satives* L) A report- compiled by F.A. Nehvi. S.K. University of Agricultural Sciences & Technology of Kashmir

Ganai, M.R.D., 2001. Nutrient status of Saffron soils and their management. *Proceedings of Seminar-cum-Workshop on the Development of Saffron.* S.K. University of Agricultural Sciences & Technology of Kashmir and Spices Board of India.

Gani, M.Y. 2001. Saffron diseases and their management. *Proceedings of Seminar-cum-Workshop on the Development of Saffron*. S.K. University of Agricultural Sciences & Technology of Kashmir and Spices Board of India.

Kamili, Afifa Shahin and Nehvi, F.A. 2005. Low cost solar drier in saffron. A report – S.K. University of Agricultural Sciences & Technology of Kashmir.

Kamili, Afifa Shahin and Wani. M.H. 2006. Research priority setting in saffron. A report- S.K. University of Agricultural Sciences and Technology of Kashmir.

Mathew, B. 1982. *The Crocuses: A revision of the genes Crocus (Irridaceae)* B. T. Bats Ford, London.

Mathew, B. 1999. Botany, Taxonomy and Cytology of *C.satives* L and its allies. In: *Saffron-Crocus satives* L (Moshe Negbi, ed.) Harywood Academic Publishers Australia, Canada, France.

Nehvi, F.A. 2004. Success stories of Saffron research under temperate conditions of Kashmir. NATP report. S.K. University of Agricultural Sciences & Technology of Kashmir.

Shinde, D.A; Talib, A.R; and Gorantiwari, S.M. 1984. Composition and classification of some typical soils of saffron growing areas of Jammu & Kashmir. *J. Ind. Soc. Soil Sci.* **32**:473-477.

Wani, M.A. 1994. *Distribution and forms of micronutrients cations in some saffron growing soils of Kashmir.* M.Sc. thesis submitted to S.K. University of Agricultural Sciences & Technology of Kashmir.