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Case Report

Enhancing farmer's income through strawberry cultivation under subtropical climate – a new initiative

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Abstract

New initiatives are essentially required for increasing farmer's income. Introduction of future crops in subtropics are the need of the hour in order to increase the farmers income, employment generation, to support livelihood in addition to nutritional security. In this direction an effort was initiated to introduce strawberry cultivation under subtropical environment. Ofcourse the crop is mostly grown under temperate climates; however it can be tried as an important cash crop in other climate too. The crop performed satisfactorily in subtropical Lucknow conditions of Uttar Pradesh. Three north Indian leading varieties namely Sweet Charlie, Camarosa and Winter Dawn performed nicely under different low cost tunnel structures like ventilated polytunnel, covered polytunnel and open system. A range of 176 to 260 q/ha productivity across these system were recorded in Sweet Charlie variety while in case of Winter Dawn, 175 to 245 q/ha productivity was observed. A range of 8.95-22.63g fruit weight, 0.60-0.80% acidity, 5.33-7.17°Brix TSS, 43.78-64.68 mg/100g Vitamin C and 17.19 to 25.47 mg /100g anthocyanins across the structures and varieties were estimated. In order to have an idea about the interrelationship (heat stress) among the tunnel soil temperature, air temperature and bare soil temperature, positive and significant relationship were observed among them. Farmers can get more net profit by cultivating this high value crop in this region.

Key words: Strawberry, subtropical climate, income generation, new initiatives, high value crop

Introduction

There is a need for crop diversification for increasing the farmer's income through technological interventions (1). Adoption of future crops/ new crops that are economically viable and rich in nutritional capabilities

should be given more emphasis. In this direction, the focus of current day research includes dissemination of latest agri-horti technology at farmer's door step through cost effective strawberry cultivation for enhancing their income (4, 5). Generally, strawberry is an important cash crop mostly grown under temperate climates. However, adaptation of the crops may be tried at other different climatic conditions too (6). States like Himachal Pradesh, Jammu and Kashmir, Maharashtra, West Bengal, Punjab, Rajasthan, Haryana and Delhi are the major strawberry growing states of India. It was revealed that India is earning a good amount of foreign currency by exporting around 16,000 to 18,000 t of strawberry during the year 2012. This shows that there is a scope for further horizontal expansion of strawberry cultivation.

Fig. 1: Quality strawberry under subtropical environment (ICAR-CISH, Lucknow, U.P., India)

Cultivation of strawberry in harsh climates of subtropics is difficult due to dynamic changes in weather (7). Protected cultivation is the alternative way to produce the crop under harsh weather conditions, but the cost of protected cultivation is too high. Therefore, cost effective protected cultivation should be the way forward (2). In this direction, the preset study was conducted under cost effective protected conditions to find out its effect on fruit growth, quality, yield and earliness (Fig. 1).

Materials and Methods

The work on performance of strawberry germplasm, quality and runner survival during summer seasons was conducted at research farm of ICAR-CISH, Rehmnakhera, Lucknow during 2014-16. The area is falls under subtropical climatic zone. Wider dynamics in air temperature, humidity, erratic rainfall were observed. Non availability of planting material is the major constrain for strawberry production in the northern states of India because of high temperature and erratic rainfall due to climate change. Strawberry plants are sensitive to high temperature during May-June and intense rainfall during July-September. A total of three strawberry germplasms were evaluated under cost effective structures. Polytunnel structures were prepared using plastic plumbing pipes, iron rods (*saria*) and ropes (*sutli*). Transparent plastics were covered at the top of the tunnels and black polythene covered on soil as mulching material (Fig. 2). Strawberry varieties were planted in open condition with uniform nutrient and black polythene mulching in the month of October 2015. The beds were covered from the last week of November to second week of February to see the performance of strawberry under varied growing conditions on plant growth, yield and fruit quality. Soil samples were collected for both nutrient and physical analysis. Need based irrigation were applied.

Fig. 2: Preparation of polytunnel

Results and discussion

Appraisal of soil properties

Results from undisturbed core soil samples at 0-10, 10-20 and 20-30 cm indicated that the surface soil properties

both at open system and bed conditions inside tunnel system were higher as compared to deeper depths. Surface soil (0-10 cm depth) had bulk density (BD) and particle density (PD) around 1.31 and 2.50 g cm^{-3} respectively. The water holding capacity (WHC) and porosity was estimated at 22.31 and 47.6% respectively. Lower depths (20-30 cm) had higher BD (14.5 g cm^{-3}) and PD (2.57 g cm^{-3}); also lower WHC (19.44%) and porosity (43.60%) were recorded. Macro and micronutrients of soil are in optimum range.

Performance, yield and quality evaluation

Strawberry runners in open conditions exhibited complete mortality till the month of August, while the runners planted in naturally ventilated polyhouse with roof top covered with transparent polythene exhibited survival during rainy season in the well irrigated field during summer season. Rooftop cover with 50% shade net during April - June coupled with frequent irrigation followed by side ventilated rooftop cover with transparent plastic was useful for survival of elite strawberry runners in the subtropical conditions. Performance of the crop was found to be more satisfactory under polytunnel systems. Flowering starts within first to second week of December and fruit matures within 15-20 days after fruit set (Fig. 3). The harvesting period lasts around First week of May.

Fig 3: Flowering, fruit development and harvested fruit

In open system, yield of around 200-210 q/ha was recorded whereas in other tunnel structures 245-260 q/ha. Quality parameters were also analyzed (3). Total phenols were ranged between 212.62 to 268.21 mg GAE/100g, total flavonoids as 85.67 to 127.0 mg QE/ 100g and total anthocyanins in the range of 17.19 to 25.47 mg /100g. Total antioxidants in strawberry cultivars were estimated between 1.64 to 2.16 mg /100g. Results revealed that fruit weight ranged between 8.95 to 22.63g, acidity as 0.60 to 0.80%, TSS 5.33 to 7.17°Brix and Vitamin C content in the range of 43.78 to 64.68 mg/100g across the structures and varieties. Carotenoids and Lycopene were estimated in the range of 0.59 to 1.14 mg/100g and 0.34 to 0.5 mg/100g respectively. The crop performs better under ventilated polytunnel system as compared to the open condition (Fig. 4). Wide variations in fruit length, width and antioxidant were also found in different strawberry germplasm (Fig. 5). Maximum individual fruit weight (15.8 g) was recorded in variety Kimberley followed by Missionary (14.7g), Katrain Sweet (14.1 g) and Britem (14.0 g). Delayed flowering (February first week) and early runner production (April second week) was observed in Katrain Sweet and Chandler under subtropical conditions. Maximum anthocyanin content was also recorded maximum in Kimberley followed by Duglus and Katrain Sweet.

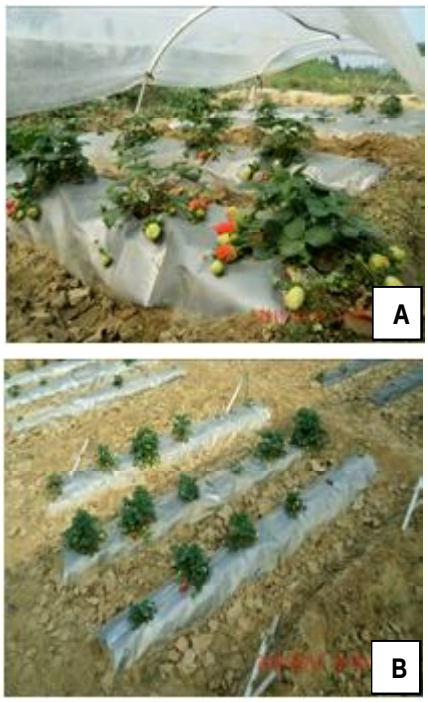


Fig 4: Strawberry cultivation. **A-** Ventilated polytunnel system, **B-** Open air system

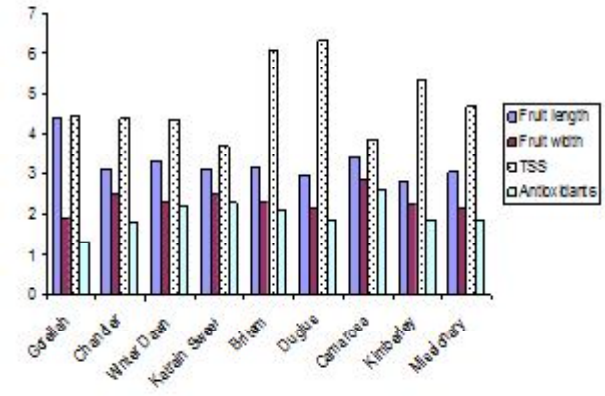


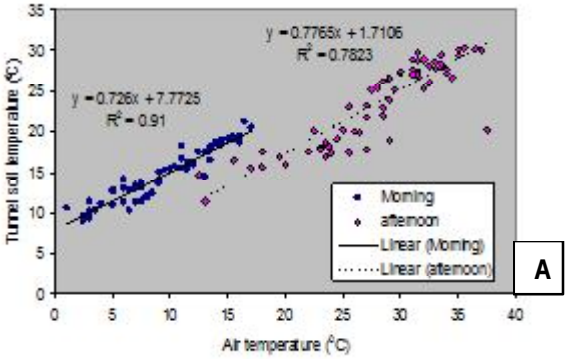
Fig. 5: Fruit length, width TSS and antioxidants in different strawberry cultivars

Var. Duglus was found best among the variety in connection with TSS (10.30) followed by Britem (10.10). Cultivation of strawberry at farmer's fields is in practice (Fig. 6).

Fig. 6: Strawberry cultivation at farmer's field

Interrelationship of soil and air temperature in open condition and inside tunnel system

In order to gain knowledge about the adaptation of strawberry in subtropical climatic conditions, both air and soil temperatures were recorded periodically. Soil temperatures were monitored at 10 and 20 cm soil depthsboth at the morning and afternoon periods in different stress mitigation structures. Clear differences in soil temperature across different systems were noted. Significant differences in the maximum and minimum air, tunnel soil and bare soil temperatures were observed. In order to understand the relationship between ambient temperature and tunnel soil temperature, linear regression analysis was employed considering the average soil temperatures recorded in 66 days across four treatments and it was observed that positive and significant relationship existed between the air temperature and tunnel structures in strawberry system (n = 66). The relationship indicated that air temperature could explain soil temperature variations under tunnel structure to the tune of 91 and 78 per cent at morning and afternoon hours respectively (Fig. 7). The prediction of tunnel soil



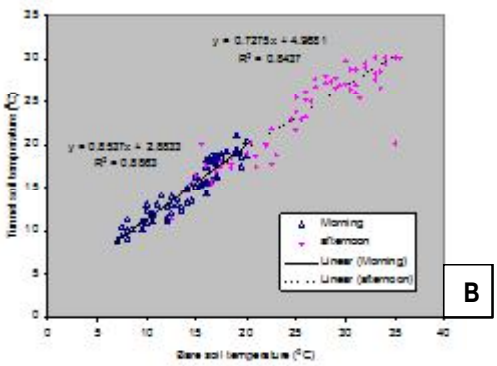


Fig 7: Interrelationship among the tunnel soil temperature , air temperature (A) and bare soil temperature (B)

temperature as a function of bare soil temperatures were also analyzed through linear regression analysis. Results showed increase in minimum tunnel soil temperature could be predicted 88 per cent from the dataset on bare soil temperature while in case of maximum temperature the corresponding value was 84 per cent (Fig. 7). Such kind of studies was needed in order to understand economic value crop like quality production of strawberry and to alter changes in adaptation strategy under changing climatic scenario.

Conclusion

The present effort was initiated keeping in view of farmers need to increase their profitability. Also there should be a provision of cultivation of new cash crops which are economically sound to this area. Strawberry cultivation is therefore successfully grown both Rehmankhera farm as well as farmers field in the same climatic condition of Uttar Pradesh. Strawberry varieties performed satisfactorily. Advancement in harvesting dates was also attained. Quality planting material can also be produced and maintained for this region. Productivity and quality components showed there is a good opportunity for commercial cultivation of strawberry at farmer's field in this region to enhance their farm income.

Author contributions

Dr. Ashok Kumar conducted the low tunnel technology experiments, collected yield data, and wrote the manuscript. Dr. Tarun Adak and Dr. Vinod Kumar Singh performed soil and climatic analysis and wrote the manuscript.

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