

STRAWBERRY CULTIVATION IN PAKISTAN WITH REFERENCE TO PESTS AND DISEASES AND THE ROLE OF IPM IN SAVING THIS NOVEL PRODUCTION

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ABSTRACT

Strawberry production as a winter crop in Pakistan on a commercial scale is a recent one, only 1.5 to 2 decades old. Yet its sustainability is threatened by pests and diseases. The strawberry aphid is not only its most serious pest but also a number one carrier of virus. The damages include curled leaves, yellowish spots and the sticky honey dew excreted by the pest. A black sooty mold often develops on the leaves reducing photosynthesis and resulting probably in the reduction of fruit yield. The strawberry mold yellow-edge virus (MYEV) and strawberry crinkle virus (CV) often cause severe damages to the plant and hence tremendously reduce the yield. The use of pesticides in a very large amount is also not a solution because its regular use produces resistance in the pest. Moreover, after the restrictions imposed by WTO in a very near future, the efforts to promote the export of this production would be in danger. The only remedy left is the continuous and strict scouting and efficient IPM strategies as discussed in the results and discussion and surveying of the plant for the pest occurrence and the, strict inspection of the incoming trans-plants. Monitoring of the aphids should start early in the crop season and should continue in the whole duration of the crop and cultural and mechanical control management steps especially checking the intrusion of the pests from the nearby areas should continue until the harvest time. These procedures hopefully would make this ingenious and most valuable crop cultivation in Pakistan sustainable and successful.

Key-words: Strawberry cultivation, diseases, pests, management, Pakistan

INTRODUCTION

Strawberry (*Fragaria amanassa* Duchesne) is being cultivated on a commercial scale for the last 15-20 years in various areas of Pakistan i.e. in Swat, Abbotabad, Mansehra, Haripur, Mardan, Peshawar, Charsadda, Gujrat, Sialkot, Jhelum, Chakwal and Karachi district. At present Islamabad, Lahore, Charsadda and Mardan are major fruit producing areas which largely cater to Lahore and Islamabad markets. The varied climatic conditions in different areas of Pakistan, make this novel cultivation the most sustainable crop with returns indeed most favourable to farmers, which makes it a remarkable enterprise. Wild strawberry plants have been growing in the hills of Gilgit, Chitral, Kaghan, Kohistan, Mansehra, Battagram, Shangla, Dir, Malakland, Abbotabad, Murree and Kashmir since ages. The widely cultivated species appears the hybrid species as the result of a cross between two species *Fragaria chiloensis* and *Fragaria virginiana* in most parts of the world (John, 1994). Its fruit appears as the most vital source of vitamin C as one gram edible portion contains 50 mg of ascorbic acid (Afridi *et al.*, 2009).

It is cultivated extensively in the northern parts of USA (recently also in Florida), USA, Italy, Japan and Mexico. In Pakistan being a newer crop, its yield yet is not up to the mark, specially in comparison to that in the countries with long term experience with this cultivar (Mabood, 1994) probably because of lack of research work, poor agronomic practices and relatively poor economic returns. In Swat a foreign company has reported a yield of 1 ton/acre (Afridi *et al.*, 2009). Both as a fresh fruit and also in the preserved form of Jams, Jellies and Squashes, used in the off-season, its benefits are enormous (Galletta and Bringham, 1995). During peak time of its fruit in the third week of March, in the wholesale market it is sold @ Rs.50/= per kg. In the big cities however, it could fetch Rs.100.00 to 150.00/= per kg on an average. The per acre income of strawberry crop may be Rs.100,000.00/= per acre. Because of this handsome return to the growers the cultivated area of strawberry crop is relatively continuously increasing year by year. For example in Charsadda its cropping area of 170 acres in 2009 increased to 200 acres in the year 2010.

It was concluded in a recent study that the optimum return from strawberry crop could be about four times higher than the optimum from sugarcane and nine times higher than wheat crop in the same acreage (Afridi *et al.*, 2009). Although the input cost of cultivation of strawberry is significantly higher than that of traditional crops like sugarcane and wheat, profit against/acre is significantly more than the input cost which is indeed encouraging. Even the poor growers who borrow money from the bank/ middle man to cultivate strawberry, not only because of the much suitable returns but also in the much less time frame from October/ November through March for fruiting through harvesting period lasts almost 30-40 days.

Strawberry is a highly perishable fruit, therefore it is a must that farmer should be imparted with training of handling and packaging of the harvested crop. It is also urgently required, needless to say, because after meeting the local consumption, this fruit has the potential to be exported efficiently to generate significantly high foreign exchange earnings by adopting suitable post harvesting technique to be marketed round the globe. The introduction of some new varieties having longer shelf life would significantly ensure the potential of the crop as an export commodity.

MATERIALS AND METHODS

The population studies of aphids were conducted in Islamabad at a small commercial experimental field of roughly 4-5 acres in single row planting @ 30 – 35 bed during January through March. Plants were looked after carefully and watered regularly. The aphid populations were counted by examining plant leaves specially leaf axils and recorded the number of wingless insects colonizing the strawberry plants from the entire plant growth period from pre-bloom period of 5 days. It was observed that with the growth of the plants the aphid populations were also increased regularly and simultaneously. In the present graph (Fig.1) the average number of aphids have been used during the entire period (50 days) after the interval of 5 days regularly.

RESULTS AND DISCUSSION

Strawberry is a commercial enterprise in result and yield of the crop has jumped by more than 300 percent in the last five years in Pakistan. It is unfortunate, however that due to lack of training in the agricultural management, cultural practices, and post-harvest efficient techniques of keeping our product in fresh condition in the packaging and other processes with perfectly cool storage and transport from orchard to foreign markets, we are unable to capture global markets and thus bear losses of millions of US\$ in foreign exchange earnings. The crop is attacked by a number of aphid species; in which the strawberry aphid *Chaetosiphon fragaefolli* (Cockerel) is probably the most important pest and attacks the strawberry crop world-wide (Blackman and Eastop, 2000). It is also a serious vector of strawberry virus *Cytorhabdo* virus. Its nymphs and adults are covered with knotted hairs and this character alone differentiates it from all other aphid species. The youngS, as well as the adults, are found underside of the leaves and suck the sap of the plant, feeding on the veinlets. This aphid species is capable of building large population. Its damage to the plant includes curled leaves, yellow spots and presence of sticky honey dew excreted by the pests. A black sooty mold often appears on the leaves which probably reduces the photosynthesis end severely effect the yield (Chen *et al.*, 1991). Strawberry mild yellow edge virus (MYEV) and strawberry crinkle virus (CV) severely reduce the crops yield. Diseased symptoms of strawberry plants transmitted by aphid species as vectors are given in the tabulated form (Table 1)

Table 1. Diseased symptoms of strawberry plants transmitted by aphid species as vectors.

S. No.	Vector s	Pathogens	Symptoms
1	<i>Chitosiphon fragaefolli</i> (Cockerl)	Virus: Cytorhabdo virus by direct transmission	Curled leaves, yellowish spots, presence of sticky honey dew with black sooty mold reducing the photosynthesis and severely affects the yield.
2	<i>Myzis persicae</i>	Mold yellow edge virus (MYEV) by direct transmission	
		Strawberry crinkle virus (CV) by direct transmission	
		Fungi by indirect transmission	Black spots on the leaves

It was observed by our team members that during the pre-bloom growth period (January to March) there were present two species of aphids i.e. our most dominant species (*C. fragaefolli*) and green peach aphid (*Myzis persicae*). Before the flowers full bloom the terminals appeared fully infested by the latter species. At the terminals

no less than six aphids were counted and our results showed thousands of aphid's counts on a single plant. As the crop matures the number of aphid population recorded to be high in 30-50 days during the entire cultivation period of strawberry. It is entirely unknown that from where these aphids come to attack these strawberry plantations, although it is fully known that these aphids have many alternate hosts.

The aphid population showed exponential growth until 35 days after transplantation with a growth rate (compound rate of interest) of 17.87% (Fig.1). After 35 days the population sharply declined with an overall mortality of 30.33 aphids per day. The mortality was steeper during 35 – 45 days of transplantation. On 50th day aphid population size reached more or less to the initial population size (Fig. 1). The overall curve for growth until 50 days was given by the following equation:

$$\text{Aphid population} = 156.5339 - 41.926 \text{ Days} + 2.8195 (\text{Days})^2 - 0.04102 (\text{Days})^3$$

$$t = 1.48 \quad t = 2.35 \quad t = 2.83$$

$$p < 0.19 \quad p < 0.065 \quad p < 0.036$$

$$F = 7.82 (p < 0.024); R^2 = 0.8242; \text{Adj } R^2 = 0.7187; \text{SE} = 91.24$$

Effective and timely management strategies are the only solutions to the attacks of these pests and diseases. Unfortunately we could not load these cultivations with all kinds of pesticides for their injudicious use would not only be much too much expensive but also initiate resistance in the pests against pesticides and after the restrictions imposed by the WTO regulations for the safe natural pest management the chances to its future promotion to export would be entirely darkened. The only solution is IPM (Integrated Pest Management). No doubt there are pesticides which spare pollinators and other beneficial insects and target pests and show strong relative selectivity. Our results showed with some pesticides specially “primer” after their application, that only a few pollinators in the strawberry fields were found dead. Considering the future planning's of the export of the surplus strawberry fruits on a large scale, more and more IPM strategies must have to be implied.

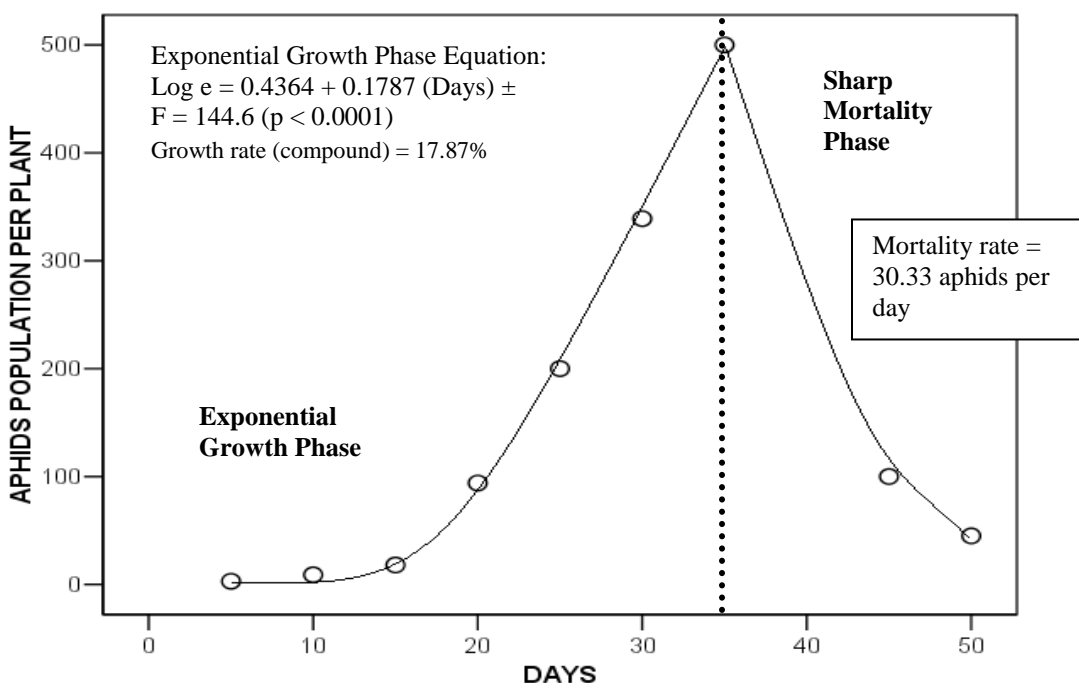


Fig. 1. Population dynamics of aphids on strawberry in terms of aphids per plant. Days signify the age of plants after transplantation.

Among these, cultural practices, strong and continuous scouting of the pests for the entire duration of the crop until harvest and mechanical ventures should be implemented. This should begin with intercropping at the plantation time, hoeing and weeding practices, mulching at in the strawberry fields especially at the beginning of the cold

season. Further more strawberries should be protected from the frost. It should be noted that yield is more frequently reduced from lack of water, poor soil drainage and poor soil physical properties than from the reduction of fertilizers in the soil. Considering the irrigation requirements of the plants in the beginning of the plantation after 7 to 10 days interval and also at the beginning of the warmer part of the year 3-5 days interval should be applied. Weed eradication should be planned and implemented one year before the plantation of the crops, if the weed problems in the area is anticipated. Pests and diseases managements especially for the aphids and fungal and viral diseases, competent management strategies outlined as above, must be followed as the key solution for the healthy crop.

At present Pakistan has very limited export of this fruit as compared to India but considering the much greater size of the European markets it is obvious that it may be the leading potential market, for export of Pakistani strawberry, also because of a sufficient seasonal advantage, to be a viable rival. Germany alone as a single potential market could consume around 600 metric tons of fresh strawberries per week and still price-wise it would be highly successful to local Pakistani exporters France, UK and Japan could also play the role of potential buyers of our strawberries. This window of opportunity to international market for our crop is available from March until July. These fresh fruits from orchard to nearby European markets could easily be air freighted with efficient cooling facilities from orchard to air transport. By over-coming our poor management, post-harvesting problems and perishability of the fruits, even the markets of USA and Middle Eastern countries would also be accessible (Aslam and Rasool, 2011).

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