

## Farmers' Perceptions about White Woolly Aphid in Sugarcane and its Management Practices

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### ABSTRACT

*Sugarcane woolly aphid (SWA) is a serious pest of sugarcane in several parts of the Oriental region. The species is known from several countries of Asia with variable pest status. Although not new to the crop or crop regions of the world, the pest has been reported in severe forms in India only after 2004. Compiled information is meager on the effects of this pest on sugarcane yield and quality or the economic consequences for rural producers. Hence, a study was conducted to investigate the cane growers' understanding and perception of white woolly aphid in sugarcane. Data on farmers' perceptions were collected in two divisions of a sugar factory using participatory approach and household surveys with a total of 90 households. Five point, Likert-type response scale was used to measure farmers' perception. Almost all the farmers have realized that SWA is an invading pest and the incidence starts in the border of the fields and gradually spreads inwards by proliferating quickly. Nearly 88% of the respondent farmers felt that the pest causes up to 75% economic loss. Being a new pest, no concrete management measures were available then. Nevertheless, the farmers had used acephate and phorate that are being recommended for other sucking pests. The study concludes that while this situation presents new challenges to agricultural scientists, it as well offers opportunities to find innovative ways to combat the emerging pests using new frontier technologies.*

**Key words:** Perception; Farmers' knowledge; Participatory approach; White woolly aphid; Management practices;

Among the biotic stresses, pests and diseases pose a major threat to sugarcane cultivation. Nearly 210 insect pests are reported to infest the crop, of which borers and sucking pests are of economic importance (Salin and Srikanth, 2011). While many species of sap feeders are associated with sugarcane, only a few including woolly aphid can be considered as serious economic pests in Indonesia, China, Myanmar and Vietnam (Leslie, 2004).

Sugarcane woolly aphid (SWA), *Ceratovacuna lanigera* Zehntner (Homoptera: Aphididae) was reported to have first occurred in West Bengal in the late 1950s (Basu and Banerjee, 1958). After remaining dormant for several decades, SWA invaded Maharashtra and Northern Karnataka during 2002. Subsequently, it spread to parts of Tamil Nadu and Andhra Pradesh (Rabindra and Mohanraj, 2004). The pest became a threat to reckon with in all the major tropical sugarcane growing areas during 2004-07.

Indian agriculture has witnessed epidemics of several pests, both indigenous and exotic, in the last

decade in different crops at varying intensities. The long list includes subabul psyllid, spiraling whitefly, coconut mite, etc. Sugarcane, a major economic crop after cotton, too fell victim to such onslaught that came in the form of the woolly aphid (Srikanth, 2007). Although not new to the crop or crop regions of the world, the pest has never been reported to occur in as intense form (Pemberton and Williams, 1969).

Exact information is currently meager on the effects of this pest on sugarcane yield and quality or the economic consequences for rural producers. Preliminary survey indicated that woolly aphids cause substantial losses to sugarcane crop. This study was initiated to document farmers' perceptions of white woolly aphid in sugarcane and to assess the management practices followed by cane growers.

### METHODOLOGY

The study was conducted in Tirupur and Coimbatore districts of Tamil Nadu. These two districts lie in an agro-ecological region of high agricultural potential with an average annual rainfall of 600 to 700 mm with

moderate temperatures (28 - 36°C). The area is dominated by soils of high inherent fertility. The major crops grown are paddy, coconut, sugarcane, turmeric, banana besides vegetables.

The methodology of this study combined participatory rural appraisal (PRA) techniques with quantitative household surveys with open and semi-structured questionnaire. The questionnaire aimed to get i. an accurate overview of farmers' perceptions of the new pest ii. socio-economic characteristics of the participating farmers, and iii. a picture of the current practices of the stakeholders involved in sugarcane production to combat the new pest. The content of the questionnaire and type of questions was agreed upon key informant interviews. The combination of methods in the research process helped to establish complementarities of results from quantitative analyses and those carried out by communities through local knowledge systems and qualitative PRA process. Through triangulation of methods, the study integrated knowledge from within and between scientific and local bases to establish balance and avoid making conclusions based on unverified local assumptions (*Reed et al 2007*).

The survey was conducted during March 2007 to January 2008 in the two districts of Coimbatore and Tirupur. These two districts comprise the registered cane area of Bannari Amman Sugars Limited, a leading private sugar mill in Tamil Nadu state. The total registered cane area in a sugar mill is divided into divisions and each division comprises 4-6 sections. There are 12 divisions in Bannari Amman Sugars Ltd., out of which two divisions, Perur and Annur division with maximum percentage of sugarcane woolly aphid incidence were selected based on information from previous surveys on aphid incidence. The number of farmers growing sugarcane in the division was estimated from the list of cane growers maintained in the mill with the assistance of Cane Officers and other field staff in the divisions. The fields with severe infestation were included in the study. A sample of 90 sugarcane growers (45 from each district) were selected by random sampling from two divisions in each district. Household heads were randomly selected and interviewed in their farms, in villages and in their fields. Their responses to questions on household characteristics, constraints in sugarcane production, perception about the pest, and management measures followed were obtained.

The data collected were tabulated and analyzed using descriptive statistics including frequency distribution, percentages, mean and standard deviation to derive at conclusions. For the perception analysis, 15 statements were developed regarding the new pest using five point Likert – type scale responses. The choices were: 1 = strongly disagree, 2 = disagree, 3 = neutral or undecided, 4 = agree and 5 = strongly agree for positive statement and a reverse system of scoring for negative statements. The statements were made through consultations with the Subject Matter Specialists from the Division of crop protection in Sugarcane Breeding Institute and cane development personnel from Bannari Amman Sugars and through focus group discussions with cane growers. The perception section of the statements was assessed by calculating a Cronbach's alpha coefficient as a measure of instrument reliability/ internal consistency to analyze interval data in psychometric test score. The Cronbach's alpha coefficient used for the statements for this section was 0.82.

## RESULTS AND DISCUSSION

*Household and farm characteristics:* The age of the household heads of farm families interviewed ranged from 29-64 years (Table 1) with an average age of 44.3 years. Fifty six percent of the household heads were between 35 and 50 years old and 35% of the household heads were older than 50 years. The remaining proportion of households (11%) was led by young males who were younger than 35 years. Majority of the households were headed by males (92.22%). There was no illiterate farmer in the sample surveyed. Majority (63.33%) of them had secondary level of education. It is heartening to note that 10% of them had college level of education. Household family size ranged between three and seven persons, with an average family size of 3.8 persons.

The farming system in the region was characterized by small holdings with a maximum size of 22.00 acres and mean land size of five acres. On an average, 56% of land is allocated to sugarcane crop as it has assured market and gives remunerative returns.

Sugarcane is grown as a traditional cash crop in that area. The crop is grown and mostly supplied to sugar mills. It also serves as a fodder for their cattle. The other crops include banana, turmeric and paddy apart from vegetables.

**Farmers' perception of constraints :** Sugarcane growers listed a total of eight constraints upon sugarcane production. Non availability of labour (93.33%) and high cost of labour (90%) was mentioned as the major problems followed by non-availability of inputs in time (82.22%) and non-availability of planting materials of new sugarcane varieties (76.67%). Incidence of pests, diseases, weeds and lack of adequate irrigation water were also among the other problems as experienced by cane growers. All these constraints directly or indirectly have a profound influence on sugarcane productivity.

**Farmers' perceptions about woolly aphid :** Pests, or the damage symptoms they cause, are seen as more damaging than perhaps they are and they thus stimulate overreaction. The farmers' response to pest damage reflects their perception of anticipated losses rather than actual losses. The tendency to overestimate actual losses caused by insect pests, and aggressive marketing campaigns, has strongly influenced pesticide misuse as well (Escalada and Heong, 1993). Knowledge of

**Table 1. Household and farm characteristics of respondents (N = 90)**

S.No.	Characteristics	Tirupur	Coimbatore	Average
1.	Age			
	Average	42.7	45.9	44.3
	Range	31 –64	29 -58	29-64
2.	Gender			
	Male	42 (93.33)	41 (91.11)	83 (92.22)
	Female	3 (6.67)	4 (8.89)	7 (7.77)
3.	Schooling			
	Primary	15 (33.33)	9 (20)	24 (26.67)
	Secondary	26 (57.78)	31 (68.89)	57 (63.33)
	College	4 (8.89)	5 (11.11)	9 (10.00)
4.	Family size			
	Average	3.4	4.2	3.8
5.	Land size in acres			
	Average	4.80	5.20	5.0
6.	Area under sugarcane (%)			
	Average	43	59	56
	Range	40 –100	2 –100	40-100

(Data within parenthesis indicate percentages)

pests varies between farmers working in similar or different agro-ecosystems. In some cases, pest recognition is a major problem, while in others knowledge about pest ecology is the major constraint (Van Huis and Meerman, 1997).

Sugarcane woolly aphid is a gregarious pest living as large colonies, sucking phloem sap from leaves and excreting honeydew onto foliage leading to sooty mould development. The relief is that it is not a vector to any disease in sugarcane. And it does not discolour or deform sugarcane leaves as in apple woolly aphid or cotton aphid or citrus aphid (Geetha, 2007).

Farmers' perceptions on the different statements about the pest were measured by using rank order of the statement using mean and standard deviation (Table 2). The incidence of woolly aphid is seen in the border

**Table 2. Perception of farmers about woolly aphid**

Rank	Perception of farmers	Mean	SD
1.	Incidence is first seen in the borders of the field and shady areas	4.29	0.86
2.	The pest proliferates quickly and spreads horizontally	3.78	1.03
3.	High yielding sugar rich varieties is a pre-disposing factor	3.69	1.12
4.	Monocropping of sugarcane has attracted this new pest	3.36	1.07
5.	Heavy rains reduce the population by dislodging	3.09	1.19
6.	Severe infestation leads to stunted growth and yield reduction	2.97	1.23
7.	Poor germination in ratoon crop if plant crop is infested	2.78	1.17
8.	Infestation leads to loss in fodder value	2.42	1.16
9.	Feeding infested leaves to cattle leads to dysentery	2.21	1.08
10.	Detrashing in infested crop causes skin irritation and allergies	2.17	1.31
11.	The pest cannot be managed by the insecticides available in the market	2.12	1.26
12.	Application of Phorate limits the further spread of the pest to nearby areas	2.08	1.29
13.	Heavy wind aids in spreading the infestation to other fields	2.02	1.28
14.	Woolly aphid infested canes produce poor quality jaggery	1.98	1.04
15.	Market value of affected canes is reduced significantly	1.92	1.21

of the field initially and gradually the pest spreads inwards. Almost all the farmers have realized this fact and no doubt this statement ranked first. The pest is proven to be an invading pest and has the potential of one individual proliferating to 2210 million within a month and spreads like wildfire (*Mukunthan et al 2007*). This has been perceived by the farmers in the second rank that it proliferates quickly and spreads horizontally.

The other four statements in their order of importance indicate the rationality and the farmers reasoning for the occurrence of the pest all of a sudden. This also indicates that sugarcane growers had keenly observed the pest and analyzed the pre-disposing factors. It is an accepted fact that continuous cultivation of any crop in the same field consecutively for many years invites many new pests and diseases (*Bailey, 2004; Leslie, 2004*). This has triggered the incidence of woolly aphid in sugarcane as well, which was hitherto an unknown pest in sugarcane. Being a new pest, farmers were not aware of the scientific management measures for this pest.

*Extent of economic loss due to woolly aphid attack:* Sugarcane agro-ecosystem under tropical condition is diverse. Owing to the variation in the climate and cultivation of sugarcane as a monoculture temporally and spatially the pest proliferates.

The infested leaves do not show any discoloration due to SWA infestation. But when young crop of 3 to 4 month age is attacked, the crop becomes stunted. The reports (*Rabindra and Mohanraj, 2004*) on the extent of loss due to SWA infestation are alarming. An yield and quality loss of 25 to 30 per cent, failure of sprouting of ratoons and loss of fodder value of cane tops due to the presence of vast populations of SWA, sooty mould and insecticidal residues are reported.

Ever since the invasion and spread of sugarcane woolly aphid in peninsular India, varying levels of yield and quality losses were reported (*Joshi and Viraktamath, 2004; Srikanth, 2007*). In Maharashtra, reduction in cane yield to the tune of 25-36 tonnes/ha and losses in sugar recovery in the range of 1.20-3.43% in three varieties (Co 86032, Co 8011 and CoC 671) have been reported (*Patil et al., 2004*). Reduction in recovery in the first year of occurrence of the aphid over the recovery in the previous pest free year in the sugarcane varieties Co 8011 and CoC 671 was also reported from Karnataka with the observation that drought may have partly confounded the effect of the aphid (*Kulkarni, 2004*).

Woolly aphid was capable of inflicting loss in individual canes under certain conditions. However, actual losses in the field would depend on the extent of attack of plant and leaf populations, intensity of colonization of individual leaves, duration of aphid colonization and population fluctuations during the period of colonization (*Mukunthan et al., 2008*).

The participant farmers in general, interviewed could not estimate the exact quantum of yield loss either in tonnage or monetary value (Table 3). Under severe infestation, farmers burnt the entire field without harvesting the crop indicating total loss. This happened in areas where the canes are used either for juice purpose or jaggery making. Farmers believe that jaggery recovery from the woolly aphid affected canes is considerably less and the quality of jaggery in terms of colour and clarity is reduced. Jaggery setting is reported to be relatively difficult.

SWA was capable of inflicting loss in individual canes. However, actual losses in the field depend on the extent of attack of plant and leaf populations, intensity of colonization of individual leaves, duration of aphid colonization and population fluctuations during the period of colonization (*Mukunthan et al, 2008*). The copious honeydew secreted by the aphids is dropped on the upper surface of the lower leaves leading to the growth of the fungus *Capnodium* spp. interfering the

**Table 3. Farmers' response on the economic loss of infected canes**

Economic loss	No.	%
>75%	08	8.89
50 - 75%	37	41.11
25 - 50%	32	35.56
<25%	11	12.22
No effect	02	2.22

photosynthesis. During severe infestation the 'sooty mould' also develops on the lower surface of the leaves towards the margins. Excessive infestation causes stunted growth and gradually complete drying of leaves is noticed (*Takara, 1968; Phukan et al., 1977; Hill, 1993; Patil et al., 2004*).

Some earlier studies that reported decrease in selected yield and juice quality parameters similarly did not relate them to aphid intensity (*Patil et al., 2003*) or at the most attempted to use arbitrary infestation levels (*Kulkarni, 2004*).

*Pest management practices followed by farmers :* One of the major constraints upon establishing an IPM

programme is the lack of adequate information about farmers' knowledge, perceptions and practices in pest management (Heong, 1985; Teng, 1987; Morse and Buhler, 1997). If scientists have to work with farmers to improve crop production and crop protection, they should recognize farmers' constraints and their existing technical knowledge (Kenmore, 1991; Bentley, 1992; Morse and Buhler, 1997).

Woolly aphids, being a new pest to sugarcane, proper recommendation of scientific management measures were not available then. The numerical superiority of the pest by way of parthenogenetic reproduction and the late arrival of the predators create a wide predator prey ratio which delays pest suppression. As a consequence, the damage inflicted by the pest prolongs. So, both to bring equilibrium in woolly aphid infested area and to immediately minimize the damage intensity in those places, intervention with insecticide becomes imperative. The recommended insecticide, as in the case of any other sucking pest is acephate and the same was used by 63.33% of the respondents. SWA being a sucking pest should be checked with insecticides that have both contact and systemic action to bring immediate kill and long lasting protection to the treated surface. So insecticides with contact and systemic action such as acephate 75 SP, dimethoate 35 EC, and monocrotophos 40 EC are the best for SWA control (Singaravelu, 2007). The field staff of the concerned sugar mill had alerted the cane growers about the need to spray insecticides. Woolly aphid being a quick proliferating and fast spreading pest, insecticides are the only tool to immediately check its rate of proliferation (Table 4).

**Table 4. Woolly aphid management in sugarcane fields**

S.No.	Management practice	No.	%
1.	Application of phorate granules by broadcasting	48	53.33
2.	Spraying acephate insecticide	57	63.33
3.	Mixing insecticides and spraying over the crop canopy	23	25.56
4.	Tying cloth packs of phorate granules to the leaf sheath	17	18.89
5.	Water spraying on the border rows during initial infestation	06	6.67
6.	No management measure adopted, left for natural control	9	10.00
7.	Defoliation	4	4.44

When granular systemic insecticides like phorate 10 G, carbofuran 3G, fipronil 3GR were applied better control was obtained with phorate 10G @ 2.5 to 3.0 kg ai/ha. However, our studies indicated that phorate was not as effective as spray formulations (Patil et al., 2004). More than half of the respondents in this study applied phorate granules by broadcasting on the leaves. Tying of cloth packs containing phorate granules in the leaf sheath was noticed in Puttuvikki village and nearby areas in Coimbatore district. The farmers felt that the fumigating action of phorate granules reduces the pest population and thereby limits further spread.

Mixing several insecticides or use of excess dose of an insecticide should be avoided to prevent SWA developing resistance to insecticides besides higher expenditure and pollution. Instead, for maximum per cent kill, thorough covering of the undersurface of leaves with the recommended insecticide is essential. However, nearly one fourth of the respondents made a cocktail of insecticides with the intention that at least one chemical or other would manage the pest. No two insecticides should be combined and sprayed. This would favour SWA to develop resistance to several insecticides simultaneously and destruction of natural enemies will be more severe (Singaravelu, 2007). Field sanitation by removal of the infested plants was done by few farmers; but the pest had a rapid horizontal spread to the entire field within a short period that made roguing impractical. Farmers also felt that heavy rainfall temporarily reduces the pest population.

Nearly five per cent of the respondents defoliated sugarcane stalks so as to expose the stalks to sunlight directly. Detrashing is a common cultural practice of removing the dried sugarcane leaves during 5th and 7th month to prevent lodging of cane in later stage as well as to ward off the infestation of sucking pests. It is also done to have maneuverability for monitoring and spot application of insecticides. Detrashing minimises the strata for the development of sooty mould and so the sickly appearance of the field is averted. But, in this case, even the fresh leaves were removed as a preventive measure which was rather very tedious and uneconomical. Destroying the entire crop by burning was done by three farmers due to extreme damage. However, this is not a healthy practice as it results in total crop loss to the farmer.

## CONCLUSION

Worldwide, sustainability of agricultural systems has received more and more emphasis over the past decades, though successes have been highly dependent on type of

crop and region (Mengech *et al.*, 1995, Morse and Buhler, 1997). Evaluating farmers' knowledge and perception of pests and natural enemies is especially useful to set research agendas, for planning campaign strategies and developing messages for communication (Fujisaka, 1992; Escalada and Heong, 1993). Technologies are viable only when they are used by farmers. No matter how well new technologies work on research stations, if farmers will not have them for use, their development would have been in vain (Sandra *et al.*, 1989).

In this study it is recommended to increase common

understanding of the pest damage and impacts on crop yield especially the varied management measures – chemical and biological. Increasing farmers' knowledge and perception may be the important consideration for the dissemination of any improved technology to the cane growers. To realize this, participatory experiments can be used as an effective approach to transmit abstract concepts by making things visible and to show farmers that alternative effective approaches are possible for pest management.

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