Biolife
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
3(2):540-546
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE RESEARCH ARTICLE

Colour attractivity and occurrence of some cell sap sucking pests on crop plants

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ABSTRACT

The colour of plant parts, light and texture play an important role in attracting insect pests and further their utility in pest management. There is extreme need for pesticidal alterations in integrated pest management. Therefore, manipulation of colours in pest management is worthwhile ecofriendly strategy of pest control. Four sap sucking pests namely spiralling white fly *Aleurodicus dispersus*, mealy bug *Coccidohystris insolita*, aphid *Aphis craccivora* and a psyllid *Heteropsylla cubana* were tested under laboratory conditions (27±1ºC, 75-80% R. H., 12 hrs photoperiod) against 7 colours for their attractive preference. Above species showed maximum preference to yellow, red, red and yellow colours respectively. During the kharip and rabbi seasons the occurrence of above pests was studied with respect to colour of flowers. The sucking insect pests were more common on crop plant of yellow flowers.

Key words- Colour attractivity, sucking insect pests, crop plants, ecofriendly control.

INTRODUCTION

Insects attract towards the different colours for the purpose of food, navigation, protection etc. Scientists believe that insects that fly at night evolved over millions of years before the humans existed. There was no artificial light at night before humans existed except the light of moon. Insects fly directly towards the moon at night in the dark, now a days so many artificial lights and attractive colours are available and relatively insects attract towards natural style. This habit of insect can be used for controlling some harmful insects. Many insects have receptors that can process light beyond our own visual spectrum; therefore, they can see the colours that don't look to humans. Generally, nocturnal insect pollinators attract to the white colours which have high contras of white day. Flying pollinators mostly attract to blue violet and red colours. However, the light plays an important role in the reaction of insects. This light reaction is called phototropism. Maximum insects attract to light. Short wavelength lights, such as blue and violet are usually more attractive to insects than other colours (Stark and Tan, 1982).

Sticky traps, light traps and pheromone traps are widely used for monitoring and controlling the insect populations. Thus the use of colour traps for controlling insect pest populations is one of the very good insect control measures. Insect control capacity depends partly on the mobility of the insects. Hence, colour traps are usually more effective in catching adult insects.

Review of literature indicates that Vaishampayan *et al.* (1975), Stark and Tan (1982), Prokopy and Owens (1983), Sathe *et al.* (1987), Byrne *et al.* (1990), Oosman (1996), Wolfe *et al.* (1998), Chu *et al.* (2000), Bi *et al.* (2001), Hamilton and Brown (2001), Oliveida *et al.* (2001), Alegbejo and Banwo (2005), Chu *et al*.(2007)etc. worked on colour attraction by insects.

How to cite this article:
T. V. Sathe, Anna Gophane and Nilam Shendage (2015). Colour attractivity and occurrence of some cell sap sucking pests on crop plants. Biolife, 3(2), pp 540-546.

In the present work four cell-sap sucking insect pests namely white fly *Aleurodicus dispersus*, mealy bug *Coccidohystris insolita*, aphid *Aphis craccivora*, and Subabul psyllid *Heteropsylla cubana* were selected for the colour attraction behaviour and occurrence on different crop plants in Kolhapur region, India. In the field, above pest species have been surveyed on colour flowers of different plants from Kolhapur region by one man one hour search method. Spot observations on association of pest species and coloured flowers of host plants were taken into account.

All above insect pests cause the damage to agricultural and horticultural crops by sucking the cell sap resulting in curly and yellowing of leaves, dropping down of flowering and fruiting bodies, causing sooty mould on leaves, affecting photosynthesis and growth and finally the yield of the crops. These pests are difficult to control with pesticides since they have developed resistant to various pesticides belonging to chlorinated hydrocarbons, organophosphorus, carbamates, and synthetic pyrethroids. Therefore, use of coloured traps would be crucial alternative for the use of pesticides against sucking type of insect pests.

MATERIALS AND METHOD

Initial culture of insect pests has been maintained in the laboratory by collecting adults and nymphs of *A. dispersus*, *C. insolita*, *A. craccivora* and *H. cubana* from various crop fields of Kolhapur during the years 2012-2013. Laboratory reared insects have been used to study the colour response under laboratory conditions 27±1ºC, 75-80% R. H., 12 hr photoperiod. Eight different colour papers i.e. Red, Yellow, Green, Blue, Brown, White, Orange and Sky blue were used. In the experiment the colour papers in the form of triangles were pasted in the circular glass petridish of size 19 cm diameter (Figure-1). Four experimental petridishes were used for colour attracting behaviour of above pests. 100 individuals of each pest were kept at the central round of the experimental petridish. The insects start crawling towards the preferable colour. After 1 hr, the number of insects settled on specific colour was counted. On the basis of highest number settled on specific colour, the colour attractiveness was finalized.

The occurrence of *A. dispersus*, *C. insolita* and *A. craccivora* on economically important crop plants was studied by spot observations and counting number of insects present on the coloured flower at weekly interval during the monsoon/ kharip season as per the availability.

RESULTS

Colour responses of four cell sap sucking insect pests are recorded in tables 1 and 2. The results recorded in tables 1 and 2 and figs 1 to 9 indicated that *A. dispersus* and *H. cubana* were attracted to yellow colour while, *C. insolita* and *A. craccivora* attracted to red colour mostly.

1) **White fly** (*A. dispersus*):

Eight different colours were tested against sucking insects. Out of which maximum white fly *A. dispersus* attracted towards the yellow colour followed by green and brown (Table-1). Red and blue colours were less attractive to whitefly. Better response was noted to

Figure-1. Colour preference by sap sucking insect pests.

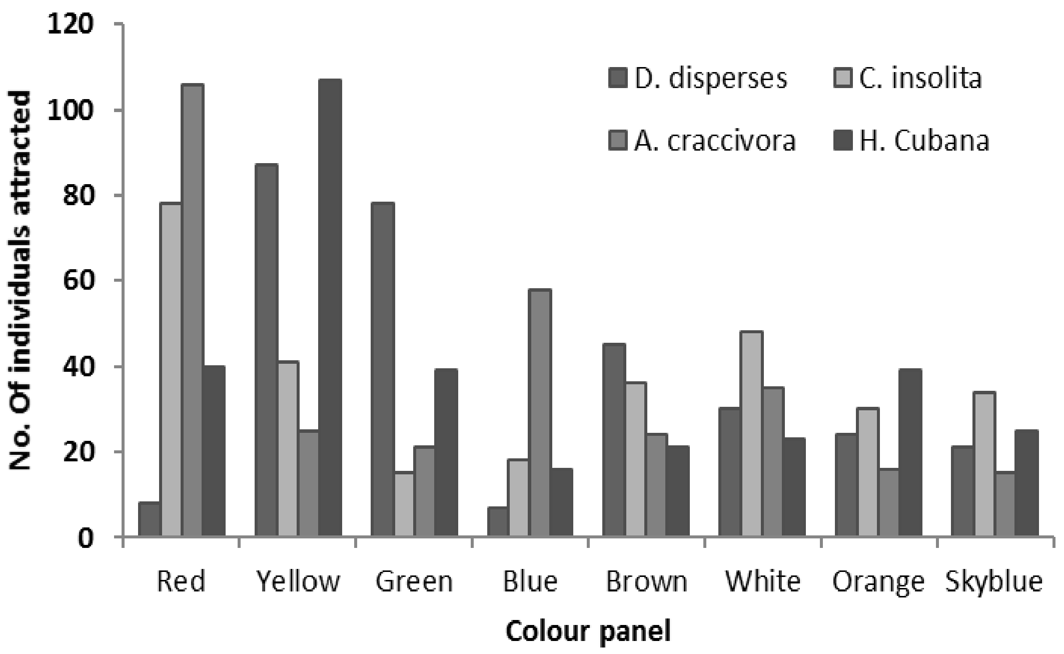

Table 1: Colour attractivity in cell sap sucking insect pests

Sr. No.	Colour	No. Of individuals attracted			
		A. dispersus	*C. insolita*	*A. craccivora*	*H. cubana*
1	Red	8	78	106	40
2	Yellow	87	41	25	107
3	Green	78	15	21	39
4	Blue	7	18	58	16
5	Brown	45	36	24	21
6	White	30	48	35	23
7	Orange	24	30	16	39
8	Skyblue	21	34	15	25
	Total	300	300	300	300

Table 2: Occurrence of cell sap sucking insect pests on crop plants in field

Plant Species	Season	Colour of flower	Size of flower (cm)	Number of pests per flower		
				A. craccivora	*A. dispersus*	*C. insolita*
Cajanus cajn Mills.	Kharip	yellow	2.00X3.00 (6.00)	10.00	10.00	0.00
Vigna sinensis L.	Kharip	white	2.50X3.00 (7.50)	15.00	15.00	2.00
Carthamus tinctorius L.	Rabbi	yellow	3.15X6.00 (18.80)	32.00	12.00	0.00
Carthamus tinctorius L.	Rabbi	red	3.15X6.00 (18.80)	14.00	8.00	0.00
Arachis hypogea L.	Kharip	yellow	2.50X2.00 (5.00)	13.00	18.00	0.00
Solanum malongena L.	Both	light bluish	3.00X2.00 (6.00)	8.00	12.00	12.00
Hibiscus rosasinensis L.	Both	red	10.00X9.00 (90.00)	65.00	16.00	3.00
Moringa oleifera Lam.	Both	white	2.50X3.00 (7.50)	6.00	5.00	0.00

the brown, white, orange, sky blue as compared to red and blue. The order of preference to different colours given by *A. dispersus* refer to yellow> green> brown> white> orange> skyblue> red> blue (Table-1). However, in the field condition season wise preferences were different (Table-2) on different crop plants (*C. cajan, V. sinensis, C. tinctorius, A. hypogeal, S. melongena, H. rosasinensis* and *M. oleifera*). Yellow and white coloured flowers were more attractive to the white flies on the crop plants

2) Mealy bug (*C. insolita*):

For mealy bug *C. insolita,* red colour was most attractive (Table-1). The order of colour preference in the laboratory (27±ºC, 75-80% R. H and 12 hr photoperiod) was red> white> yellow> brown> skyblue> orange> blue> green. The green and blue colours were less attractive to *C. insolita.* In the field condition, mealy bug were mostly attracted to light blue and white coloured flowers (Table-2).

3) Aphid (*A. craccivora*):

Maximum attraction of ***A.*** *craccivora* was towards the red colour followed by blue, white, Yellow, brown, green, orange and sky blue. Orange and sky blue colours gave less response. Blue colour also gave better response as compared to the brown, white, blue, sky blue and green colour. In the field condition white and yellow colours were most attractive in the form of flowers.

4) Psyllid (*H. cubana*):

Table-1 indicates that the psyllids were responsive to eight different colours under laboratory conditions on colour panels. In this experiment, maximum psyllids were attracted towards the yellow colour and least to the blue colour. The order of colour preference was yellow> red> orange> green> sky blue> white> brown> blue. However, orange, green and red colours were also good attractants for insects.

Figure-2. Colour attractive panels for *A. dispersus*.

Figure-3. *A. Crassivora*

Figure-4. *A. dispersus* (adults)

Figure-5. *C. insolita* on *S. malongena* leaf

Figure-6. *S. malongena* flower

Figure-7. *C. insolita* damage to *S. malongena*.

Figure-8. ***H. rosasinensis*** **flower**

Figure-9. ***M. oleifera*** **flowers**

DISCUSSION

According to Giurfa *et al.* (1995) and Horvath *et al.* (2002) the insects phototropism and colour vision, considered to be the most important factors that help in identifying its food source. They use the different colours to distinguish between the host and the surrounding environment (Begum *et al.*, 2004). Chu *et al.* (2000) examined nine different colours that used to record the attraction of whitefly *Bemisia argentifolii* (Bellows and Perring) with a wavelength range between 490-600 nm wherein the most attractive colours were yellow, green, blue and the spring green. Mohamed (2007) studied the attractive colours and adaptive directions in *B. tabaci* and proved that the yellow colour was more significant from bluish green and then the orange, indigo and the green.

Colours were one of the attractants that have been tested and used to attract insects (Thein, 2011). Insect response to colour was dependant on the ground composition, physiological state of the insect and quality of incident light wave length (Prokopy & owens, 1983). Thein *et al.* (2011) studied the attractiveness of various colour of sticky traps and light traps at sugarcane field in Phandon village, Kampawap district, Vron Thani Province, North east region of Thailand. They used colour attractant traps against the leafhoppers *Mastsumuratetti hiroglyphicus* (Matsumara) and *Yamatotettix flavovittatus* Matsumara, for this experiment yellow, blue, white, green and orange colours were used. They reported a high number of *M. hiroglyphicus* and *Y. flavovittatus* trapped on blue and yellow colour as compared to white, orange, green and colourless traps. In light trap experiments yellow, green, blue, skyblue and orange colour light sources were used to trap insects and were found significantly more attractive to both species of leafhoppers compared to sticky colour traps. They concluded that a trap with black light and blue colour was the best attractive for monitoring the sugarcane leafhopper.

According to Saleh *et al.* (2010) yellow colour was significantly the most attractive colour, while blue and violet were the least colours preferred by *B. tabaci*. They further stated that the orange colour comes after the yellow colour which was the most attractive colour for *B. tabaci* and orange followed by green, then blue and finally violet for both males and females of *B. tabaci*. The females were always significantly greater than males in being attracted to these colours. *Achea janata* L., *Athalia proxima* Klog., and *Zonabria postulata* T. showed a common strong response to blue, white and green colour under laboratory conditions (24±1ºC, 55-60 % R. H.) (Sathe *et al.* 1987).

The yellow and orange colour sticky traps were significantly attractive for leafhopper, *Emposca decipiens* in cotton (Demirel and Yildirim, 2008). The red colour sticky traps caught more *Scaphoideus titamus* (a grapewine FDP-vector) than white, yellow or blue (Lessio and Alma, 2004). According to Thein *et al.* (2011) a trap with black light-blue colour was the best attractive for monitoring the insects of the vectors of sugarcane white leaf phytoplasma in sugarcane fields.

Hamilton and Brown (2001) reported bright colour of autumn foliage as a signal for aphid to indicate the tree species or individuals invested heavily in chemical defence and consequently not suitable for aphids. According to handicap-signalling hypothesis individuals within a signalling species show the variation in the expression by autumn colouration. Hamilton and Brown (2001) predicted that tree species which suffer greater insect damage could invest more in autumn colour signalling than less troubled species. Hamilton and Brown (2001) indicated that the number of aphid species was higher in tree species with higher autumn colouration index and the correlation was stronger with yellow leaved trees than with red leaved species. Holopainen and Peltonen (2002) concluded that higher number of aphids was related to the trees with bright autumn leaf colours. In the present study the insects were more commonly associated with the yellow coloured flowers/plants.

Foliar reflectance was occurred around 350-650nm, which accompanied by a lower saturation via an increase in UV and blue reflectance results in a “whitish” appearance (Prokopy and Owens, 1983). According to Thorsteinson (1958) some insects surprisingly attract towards the black colour. It was speculated that the heat absorbing properties of black colour acted as “theras lure” for some insects observed. Black colour attracted more insects in the colder months as in September and October.

Insects were sensitive to broad spectrum of light ranging from ultraviolet (UV) to red colour. Sensitivity in the UV spectrum played important role in foraging navigation in insects. This attraction to UV light has made insects a useful model for understanding visual sensitivity to UV light (Stark and Tan, 1982) and for the use in pest management since pesticidal control leads several demerits like pest resistance, secondary pest outbreak, pest resurgence and pollution.

Nitrogen concentrations or level of free amino acids in free foliage explains better aphis performance than concentration of total Phenolics including anthocyanins (Kaihulainen *et al.* 2000). The flavonoids pigments in senescing leaves accumulate only in the upper palisade of leaves (Hoch *et al.* 2001) suggest that pigments cannot be directly feeding deterrent for Phloem feeders. Probably aphids can even detoxify Phenolics in their host plants (Urbanska *et al.* 1998). Therefore, the role of anthocyanins and flavonoids in autumn leaves or aphids is of greater interest in crop-pest interactions (Sathe and Margaj, 2001; Hoch et al. 2001; Kavane and Sathe, 2014a and b). Mutikainen *et al.* (2000) reported that trees with bright colour may even attract aphids in autumn. According to Holopainen and Peltonen (2002) the frequent occurrence of migrant viviparous aphids with nymphs on yellow leaves and lower number of aphids on green leaves might be an indication that bright yellow colour of leaves acts as signal for the last winged aphid generation indicating high quality food value for its oviparous offsprings.

In the present study, under laboratory condition, out of 7 basic colours *A. despersus, C. insolita, A. craccivora*, and *H. cubana* showed highest preference to yellow, red, red and yellow colours respectively but, in the field conditions the attraction pattern was changed in some species showing that the only colours of flowers were not responsible for attracting pests on crops (Sathe, 1999; Sathe and Margaj, 2001; Sathe *et al.* 2014).

ACKNOWLEDGEMENT

Authors are thankful to Shivaji University, Kolhapur for providing facilities.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES

1. Alegbejo, M. D. and Banwo, O. O. 2005. Host plants of *Bemisia babaci* (Genn.) in northern Nigeria. *Journal of plant protection Research*, 45(2): 93-97.
2. Bi, J. L., Toscano, N. C. and Ballmer, G. R. 2002. Seasonal population dynamics of the Greenhouse Whitefly *Trialeurodes vaporariorum* (Homoptera: Aleyrodidae) on Strawberries in Southern California. *Journal of Economic Entomology,* 95(6):1179-84.
3. Byrne, D. N., Bellows, T. S Jr. and Parrella, M. P. 1990. Whiteflies in agricultural system, pp. 227-262 in D. Gerling (ed.) Whiteflies their bionomics, pest status and management, U. K.
4. Chu, C. C., Pinter, P. J. Jr., Henneberry, T. J., Umeda K., Nawick, E. T., Wei, Y. A., Reddy V. R. and Shrepatis, M. 2000. Use of CC traps with different trap base colours for silverleaf whiteflies (Homoptera: Aleyrodidae), Thrips (Thysanoptera: Thripidae) and leafhoppers (Homoptera: Cicadellidae). *Journal of Economic. Entomology*, 93 (4):1329-37.
5. Chu, C.C., Barnes, E., Natwick, E.T., Chen, T.Y., Ritter, D. and Henneberry, T. J. 2007. Trap catches of the sweetpotato whitefly (Homoptera: Aleyrodidae) in the Imperial Valley, California, from 1996 to 2002. *Insect Science*, 14:165-170.
6. Demirel, N. and Yildirim A. E. 2008. Attraction of various sticky colour traps to *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) and *Empoasca desipiens* Paoli (Homoptera: Cicadellidae) in cotton. *Journal of Entomology*, 5(6):389-394.
7. Hamilton, W. D. and Brown, S. P. 2001. Autumn tree colours as a handicap signal. *Proceedings of The Royal Society of London B (Biol. Sci.)* 268:1493.
8. Hoch, W. A., Zeldin, E. L. and McCown, B. H. 2001. Physiological significance of anthocyanin during autumnal leaf senescence. *Tree Physiol*. 21:1-8.
9. Holopainen, J. K. and Peltonen, P. 2002. Bright autumn colours of deciduous trees attract

Aphids: Nutrient Re-translocation Hypothesis. *Oikos*, 99(1):184-188.
10. Kainulainen, P., Holopainen, J. K. and Holopainen, T. 2000. Combined effects of Ozone and Nitrogen on secondary compounds, amino acids, and aphid performance in Scots Pine. *Journal of Environmental Quality*, 29(1): 334-342.
11. Kavane R.P., and Sathe T.V..,(2014a). Rearing technique for a wild silkworm Actias selene (Lepidoptera: Saturniidae). *Biolife*. 3(1).pp 1-6.
12. Kavane, R.P., and Sathe T.V.(2014b). Preliminary rearing technique for Attacus atlas (Lepidoptera: Saturniidae). A wild silkworm of India. *Biolife*. 2(4).pp 1305-1309.
13. Lessio, F. and Alma, A. 2004. Dispersal patterns and chromatic response of *Scaphoideus titanus* Ball (Homoptera: Cocadellidae) vector of the phytoplasma agent of grapevine Flavescence doree. *Agricultural and Forest Entomology,* 6:121-127.
14. Mohamed, A. M. S. 2007. Physiological studies on certain insects. M. Sc. Thesis of Faculty of Agricultural University. Alex.
15. Mutikainen, P., Walls, M., Ovaska, J., Keinanen, M., Julkunen-Tiitto, R. and Vapaavuori, E. 2000. Herbivore Resistance in *Betula pendula*: Effect of fertilization, defoliation, and plant genotype. *Ecology*, 81(1): 49-65.
16. Oliveida, M. R. V., Henneberry, T. J. and Anderson, P. 2001. History, current status and collaborative research projects for *Bemisia tabaci*. *Crop protection*, 20 (9):709-723.
17. Prokopy, R. J. and Owens, E. D. 1983. Visual detection of plants by herbivorous insects. *Annual Review of Entomology*, 28: 337-364.
18. Saleh, S. M. M., Al-Shareef, L. A. H. and Al-Zahrany, R. A.A. 2010. Effect of geomagnetic field on whitefly *Bemisia tabaci* (Gennadius) flight to the cardinal and halfway directions and their attraction to different colors in Jeddah of Saudi Arabia. *Agriculture and Biology Journal of North America*, 1(6):1349-1356.
19. Salvucci, M. E., Hendrix, D. L. and Wolfe, G. R. 1998. A thermoprotective role for sorbitol in the silverleaf whitefly, *Bemisia argentifolli*. *Journal of Insect Physiology,* 44(7-8):597-603..
20. Sathe T. V. 1999. Whitefly *Aleurodicus dispersus*, a new pest of guava, *Psidium guajava* in Kolhapur. *Indian J. Ent*., 61:195-196.
21. Sathe, T. V. and Margaj, G. S. 2001. Cotton pests and biocontrol agents. Daya Publishing House, Delhi, pp 1-147.
22. Sathe, T. V., Gosavi, N. B. and Santhakumar, M. V. 1987. Behavioural responses of *Achea janata* Linn. *Athalia proxima* Klog. and *Zonabria postulata* T. to different coloured lights. *Science and Culture*, 53(1):18-19.
23. Sathe T. V., N. T Sathe, D. Ghodake and Asawari Sathe. 2014. Sucking insect pests and medical value of Tulsi *Ocimum sanctum* L. (Lamiaceae) *Indian J. Appl. Res.,* 4(3):336-338.
24. Stark, W.S. and Tan, K.E. 1982. Ultraviolet light: photosensitivity and other effects on the visual system. *Photochemistry and Photobiology,* 36(3):371-80.
25. Thein, M. M., Jamjanya, T., Hanboonsong, Y. 2011. Evaluation of colour traps to monitor insect vectors of sugarcane white leaf phytoplasma. *Bulletin of Insectology,* 64 (Suppl.): S117-S118.
26. Urbanska, A., Tjallingii, W. F., Dixon, A. F. G. and Leszczynski, B. 1998. Phenol oxidising enzymes in the grain aphid's saliva. *Entomologia Experimentalis et Applicata,* 86: 197–203.

DOI: https://dx.doi.org/10.5281/zenodo.7270236
Received: 6 April 2015;
Accepted; 13 May 2015;
Available online : 7 June 2015