The Role of Altered Planting Date and Trap Crops in Reducing Pesticide Application

M. Aslam[1], H. Chahine[2] and R. Atiyeh[1]

(1) Faculty of Agricultural and Food Sciences American University of Beirut, Beirut, Lebanon

(2) Present address: Faculty of Agricultural science, Lebanese University, Beirut, Lebanon.

Abstract

Aslam, M., H. Chahine and R. Atiyeh. 1993. The role of altered planting date and trap crops in reducing pesticide application. Arab J. Pl. Prot. 11 (1): 57-53

Among cultural control technique is the manipulation of the environment to make it less favorable to the pest. Cultural control has become more important with the development of integrated pest management. Trap cropping and changing planting dates constitute useful and economical methods to manage insect pests on several crops. Both strategies are environmentally safe methods. This review provides some successful examples of the role of these two cultural practices in the reduction of pesticide applications.

Key words: Insect control, planting date, trap crop.

Introduction

Pest reliance on the use of broad spectrum insecticides for crop pest control has had undesirable consequences. In addition to adverse effects on human health and the environment; pest resistance, resurgence, and the outbreak of secondary pests have become major problems associated with insecticidal control. The rising cost of insecticides and the use of higher doses have made it imperative to investigate other control methods and incorporate several control strategies to obtain effective and economical pest management. The abuse and misuse of insecticides couple with increasing public concern about the long and short term effects of chemicals on the environment has forced farmers and researches to change pesticide use practices in agriculture. As a result there has been increased interest in integrated pest management (IPM).

Changes in application methods, improved timing of application and reduced application rate are some methods used to limit the quantity of pesticides used in crop protection. Cultural control methods, i.e., sanitation, tillage, mulching, rotation, spacing, fertilizer application, irrigation, intercropping and change in planting dates are cheaper and environmentally safe practices. These methods alone may not always control pests to the desired level but can be very effective, especially in subsistence farming systems.

Two methods i.e., intercropping, particularly using trap crops and changing planting date have been successful in reducing pesticide use while still controlling the pest population. In this paper some examples of successful IPM tactics are discussed. Areas for further IPM research are also identified.

Trap Crops:

Trap crops are grown to attract insects away from the main crop (14). Many polyphagous insects have preference for certain plant species. Monophagous species may also show preference for a specific variety of a certain crop.

Advances in research on plant-insect interactions and increased understanding of the host plant selection mechanisms in insects (9) have made trap crops a viable pest management tool.

Intercropping has been practiced for centuries in subsistence farming systems. In intercropping an attractive host may concentrate a certain pest from the other crop in a localized area where it can be effectively and economically managed. Interplanting of maize and groundnut has been reported to reduce corn barer, *Ostrinia furnacalis* Gn., damage to maize and enhance the beneficial maize planted as border trap crop had twice the number of egg masses of European corn borer, *Ostinia nubilalis* Hubn., as compared to the numbers on the main crop (7). Cabbage planted with tomato was reported to have fewer eggs of diamond-black moth, *Plutella xylostella* L., than in cabbage monoculture (15).

Higher numbers of whiteflies were found in monocultured cassava that intercropped with cowpeas (11).

Lower population of cabbage aphids on cabbage was reported in mixed cultures of cabbage and mustard than in cabbage monoculture (19).

Swezey and Daxl (32) studied the effect of cotton trap corps on 52,650 ha from 1982-1984 for boll weevil management in Nicaragua. They reported a reduction in production costs of 44% and in quantity of pesticides used 40-44%. Saxena (27) with the same rice variety as a trap crop to manage leaf hopper, *Nilaparavata lugens* (Stal), an increase in yield and a reduction in pesticide amount was obtained. In another study of the same system, the control costs were reduced from U.S. $ 192.00 to $ 14.00-28.00/ha and the amount of pesticide was reduced from 81/ha to 0.6-1.15 1/ha without any adverse effect on total rice yield (28).

Snap bean planted prior to soybean as a border trap crop has been reported to keep populations of the Mexican bean beetle out of soybean (26). In this study it was recommended that it is more economical to manage the pest with trap crop than by using insecticide if the field is 9.2 ha or larger. Leaf damage to *Chrysanthemums* by leaf miner, *Liriomiza trifolii*_(Burgess), was reported to be reduced by almost 59% when field beans were planted as trap crop (13).

Hokkanen (14) reviewed the subject and concluded that trap cropping has potential as a pest management strategy for at least 26 pest species, and has been successfully applied to control ten of them.

Planting date:

This cultural control practice disrupts the synchrony between the pest and crop by planting at a time when the pest is not present or such that a susceptible growth stage of the crop does not coincide with high pest population. This strategy has been successfully used to manage many pests.

Infestation of sunflower by sunflower moth, *Homoeosoma electellum* (Hulst), was lower in late-planted sunflower (2, 4) but seed yield was not always higher in late plantings. Similar results were obtained with banded sunflower moth, *Cochylis hospes adspersus* LeConte, and *Dactus texanus* Leconte to late planted sunflower has been reported to be lower as compared to early planted crop without any reduction in seed yield (24, 25).

Infestations by lesser corn stalk borer, *Elasmopalpus lignosellus* (Zeller), in peanut and second generation European corn borer, *Ostinia nubilalis* Hubn., in corn were reduced and yield was higher when planting of these crops was delayed (20, 18), whereas early planting of maize resulted in lower infestation of maize stalk borer, *Busseola fusca* (Fuller) (10).

Clements *et al.*(6) studied the effect of different planting of rye grass from late July to early October on frit fly, *Oscinella fruit* L., infestation and found that September and October plantings were free of infestation. They concluded that pesticide application was required only in grasses planted in August. Alfalfa planted in late fall was reported to have lower infestation with alfalfa weevil, *Hypera postica* (Gyllenhal) than when planted in early fall (8). Yield was reduced in late-planted crops, however.

Schumann and Todd (29) reported lower populations of the southern green stink bug, *Nezara viridula* L., in early planted soybeans, whereas others (22) found higher populations of this pest and lower populations of velvetbean caterpillar, *Anticarcia gematalis* Hubn. in early planted crops.

Green peach aphid, *Myzus persicae* (Sulzer) was reduced on late planted flu-cured tobacco (30) and potato (17) by late planting, but this proved uneconomical due to yield reduction or heavy damage by other pests.

Buntin *et al.* (5) showed that Hessian Fly, *Mayetiola destructor* (Say), infestation could be reduced by planting wheat from November 15th to December 1st with no yield loss or increase in fall infestations.

Masud *et al.*(21), using data from 1970-1981, reported that delayed planting in the Rolling Plains area of Texas to manage boll weevil, *Anthonomus grandis* Boheman, reduced pesticide application with an increase in net return of U.S. $ 52.78/ha. The annual saving impact was between $ 57 and $ 350 million for Texas.

Problems and research needs:

The use of trap crops and changing planting dates have limitations and constraints. There are areas that need research to exploit their full potential in integrated pest management. Some constraints and research needs are identified hereafter.

Trap crops:

A pest may have distinct preference for a certain growth stage (14). The use of trap crops requires a thorough knowledge of the insect-host interaction, especially host preference. Some studies have been done in this field in the middle east but still more research is needed. Herakly and El-Ezz (12) reported that tomato was preferred over squash, eggplant, beans and cucumber for oviposition by *Bemisia tabaci* (Genn.). In Iraq, cucumber was more attractive to whitefly than were tomato, eggplant and pepper (1). Sharaf *et al.* (31) also found higher whitefly population on tomato than on eggplant and cucumber. Before using a crop as a trap, the preference of the pest species for both trap and main crop must be determined at different growth stages of both crops and secondary pests and their preference for both trap and main crops must also be thoroughly investigated. A secondary pest of a trap crop may prefer the main crop and become a serious pest (33).

When trap crops are used they range from one to 25% of

the total cropped area (26, 27, 28). Many studies have described the preference of the pest for the trap crop, but little information is available on the effect of trap crop area whithin the main crop and its effect on reducing pest populations. Research is therefore needed on the optimum area need to be used for a trap crop.

A few workers studied the population levels of both the pest and natural enemies in trap and main crops (11). A trap crop may be attractive to both, pests and their natural enemies. If chemicals are used on trap crops thereby destroying natural enemies, pest populations may rapidly build up and spread to main crop.

The choice of trap crop should be made based on several criteria. A crop which is highly preferred by a pest may not be suitable as a trap crop, whereas it will occupy the cropped area and will receive all the inputs with the main crop. A crop with a comparatively low preference and no other use.

If a crop different than the main crop be used as a trap, it should be investigated first that no special equipment for planting and harvesting is needed,and the insects attracted by the trap crop would not be detrimental to the main crop.

Planting date:

Unfortunately most studies on manipulating planting date considered insect infestation level as a primary objective which do not show the effect of changes in planting dates which resulted in less infestation were impractical due to yield reductions (4, 17).

The location may have different effect on the same crop or variety when planting dates are changed (4, 5). Insect pest activity may also differ with regions. As a result of environment-crop-pest interactions, the relationship between low infestation levels and high yields from one area to another (2). Results derived from one area should be applied with extreme caution at other locations.

There are few studies on planting date that have considered the crop's total pest complex. Most studies consider only a single pest. Change in planting date to manage only one pest may cause secondary pest problems. A given planting date may reduce populations of one pest but increase another (3).

In areas where growing seasons are shorter and more than one crop are grown in rotation, delayed planting of one of the crops may adversely affect the yield potential of the following crop. Changing planting dates may not be practical under rain-fed germination, flowering, grain filling. etc. is a critical factor, a change in planting date to avoid pest infestation may not delayed planting may adversely affect the seed set due to onset of cold weather and frost before maturity, and early planting may adverserly affect the germination.

Most of the studies which show promise to reduce pest damage by changing planting date are done with univoltine pest species. This cultural practice may have limited or no succes against multivoltine species.

Conclusion

Trap crops and the manipulation of planting date can be effectively used in combination with other methods. These techniques are safe, economical, environmentally sound and result in reduced pesticide used.

Both strategies are crop, pest and area specific. More research is needed in areas such as trap/main crop ratio, insect-plant interactions and impact of planting date in yield. A more integrated approach in research is needed between entomologists, agronomists, ecologists, breeders and agricultural engineers.

الملخص

أسلام، محمد، هالة شاهين وروﻻ عطية. 1993. أثر تغيير مواعيد الزراعة والمحاصيل الصائدة في الإقلال من إستخدام مبيدات الافات. مجلة وقاية النبات العربية. 11 (1): 53-57.

تتضمن طرائق المكافحة الزراعية تعديل المحيط/ الوسط لجعله أقل ملاءمة للآفة. وقد تزايدت أهمية المكافحة الزراعية مع تطوير برامج الإدارة المتكاملة للآفات. وتعتبر زراعة النباتات الصائدة وتغيير مواعيد الزراعة طرائق مفيدة واقتصادية لإدارة الآفات الحشرية على محاصيل متعددة.

والإستراتيجيتين السابقتين أمينتين بيئياً ويمكن أن تتكاملا مع الطرائق الأخرى لمكافحة الآفات. وتَعْرض هذه المقالة المرجعية بعض الأمثلة الناجحة عن دور هاتين الممارستين الزراعيتين في خفض استخدام مبيدات الآفات.

References

1. Al-Hitty, A. and H.L. Sharif. 1985. Studies on host plant preference of *Bemisia tabaci* (Genn.) on some crops and effect of using host on the trap spread of tomato yellow leaf curl virus to tomato in the plastic house. Arab J. Pl. Prot. 5:19-23.

2. Aslam, M. and G.E. Wilde. 1991a. Sunflower moth control on sunflower planted on different dates in Kansas. J. Kansas Entomol. Soc. 64:51-59.

3. Aslam, M. and G. E. Wilde. 1991b. Potential insect pest of sunflower in Kansas. J. Kansas Entomol. Soc. 64:109-112.

4. Aslam, M., G.E. Wilde, T. Harvey and W.D. Stegeier. 1991. Effect of sunflower planting date on infestation and damage by the sunflower moth (Lepidoptera: Pyralidae) in Kansas. J. Agric. Entomol. 8:101-108.

5. Bunting, D., P.L. Bruckner and J.W. Johnson. 1990. Management of hessian fly (Diptera: Cecidomyiidae) in Georgia by delayed planting of winter wheat. J. Econ. Entomol. 83:1025-1033.

6. Clements, R. O., B. R. Bentley and J. W. Jackson. 1990. Influence of date of sowing on frit-fly damage to newly sown Italian rye grass. Crop Protection 9:101-104.

7. Derridj, S., H. Lefer, M. Augendre and Y. Durand. 1988. Use of strips of *Zea mays* L. to trap European corn borer (*Ostrinia nubilalis* Hbn.) oviposition in maize fields. Crop Protection 7:177-182.

8. Dowdy, A. K., R. C. Berberet and J. L. Caddel. 1986. Population densities of alfalfa weevil, *Hypera posticab* (Coleoptera: Curculionidae), with varied fall planting dates for alfalfa. J. Econ. Etomol. 79:790-796.

9. Edwards, P.J. and S. D. Wratten. 1980. Ecology of insect- plant interactions. Edward Arnold, London. 60 pp.

10. Gebre-Amlak, A., R. Sigvald and J. Pattersson. 1989. The relationship between sowing date, infestation and damage by the maize stalk borer, *Busseola fusca* (Noctuidae), on maize in Awassa, Ethiopia. Trop. Pest Management 35:143-145.

11. Fold, C. S., M. A. Altieri and A. C. Bellotti. 1989. The effects of intercropping and mixed variety of predators and parasitoids of cassava whiteflies (Hemiptera : Aleyrodidae) in Colomiba. Bull. Ent. Res. 79:155-121.

12. Herakly, F. A. and Z. A. El-Azz. 1970. The cotton whitefly, *Bemisia tabaci* (Genn), infesting cucurbits in U. A. R. Agric. Res. Rev. 48:110-118.

13. Herbert, H. J., R. F. Smith and K. B. McRae. 1984. Evaluation of non-insecticidal methods to reduce damage to *Chrysanthemums* by the leafminer *Lirimoiza trifolli* (Diptera: Agromyzidae). Can. Entomo. 116:1259-1266.

14. Hokkanen, H. M. T. 1991. Trap cropping in pest management. Ann. Rev. Entomol. 36:119-138.

15. International Rice Research Institute 1974. IRRI annual report for 1972. pp. 30-31. International Rice Research Institue, Los Banos, Philippines.

16. Interantional Rice Research Institue 1974. IRRI annual report for 1973. pp. 22-24. Interantional Rice Research Institue, Los Banos, Philippines.

17. Ioannou, N. 1989. Production of seed potatoes in Cyprus: the effects of roguing and planting date on the spread of potato leaf roll virus, tuber yield, and infestation by potato tuber moth. Potato Research 32:331-339.

18. Jarvis, J. L., W. D. Guthrie and J. C. Robbins. 1986. Yield loss from second-generation European corn borers (Lepidoptera: Pyralidae) in long-season maize hybrids planted early compared with short-season hybrids planted late. J. Econ. Entomol. 79:242-245.

19. Kloen, H. and M. A. Altieri. 1990. Effect of mustard *(Brassicae hirta)* as a non-crop plant on competition and insect pests in broccoli *(Brassica oleracea)*. Crop Protection 9:90-96.

20. Mack, T. P. and C. B. Backman. 1990. Effects of two planting dates and three tillage systems on the abundance of lesser cornstalk borer (Lepidoptera: Pyralidae), other selected insects, and yield in peanut fields. J. Econ. Entomol. 83:1034-1041.

21. Masud, S. M., R. D. Lacewell, E. P. Boring III and T. W. Fuchs. 1985. Economic implications of regional uniform planting date on cotton production system: Texas rolling plains. J. Econ. Entomol. 78:535-541.

22. McPherson, R. M. and K. Bondari. 1991. Influence of planting date and row width on abundance of velvetbean caterpillars (Lepidoptera: Noctuidae) and southern green stink bugs (Heteroptera: Pentatomidae) in soybean. J. Econ. Entomol. 84-311-316.

23. Oseto, C. Y., W. F. Burr and R. B. Carlson. 1982. Relationship of sunflower planting dates to damage by *Cylindrocopturus adapersus* (Coleoptera: Curcutionidae) in North Dakota. J. Econ. Entomol. 75:761-764.

24. Oseto, C. Y., L. D. Charlet and J. D. Busacca. 1989. Effect of planting date on damage caused by the banded sunflower moth (Lepidoptera: Cochylidae) in the Northern Great Plains J. Econ. Entomol. 82:910-912.

25. Rogers, C. E. 1985. Cultural management of *Dectes texanus* (Coleoptera: Cerambycidae) in sunflower. J. Econ. Entomol. 78:1145-1148.

26. Rust, R. W. 1977. Evaluation of trap crop procedures for control of Mexican bean beetle and lima beans. J. Econ. Entomol. 70:630-632.

27. Saxena, R. C. 1982. Colonization of Rice fields by *Nilaparavata lugens* (Stal) and its control using a trap crop. Crop Protection 1:191-198.

28. Saxena, R. C. Jr. H. D. Justo and E. L. Palangian. 1988. Trap crop for *Nephotettix virescens* (Homoptera: Cicadellidae) and tungro management in rice. J. Econ. Entomol. 81:1485-1488.

29. Schumann, F. W. and J. W. Todd. 1982. Population dynamics of the southern green stink bug (Heteroptera: Pentatomidae) in relation to soybean phenology. J. Econ. Entomol. 75:748-753.

30. Semtner, P. J. 1984. Effect of transplantation date on the seasonal abundance of the green peach aphid (Homoptera: Aphididae) and two aphid predators on flue-cured tobacco. J. Econ. Entomol. 77:324-330.

31. Sharaf, N. S., A. M. Al-Musa and Y. Batta. 1985. Effect of different host plants on population development of the sweet potato whitefly (*Bemisia tabaci* Genn., Homoptera: Aleyrodidae). Dirasat VII:89-90.

32. Swezey, S. L. and R. G. Daxl. 1988. Area-wide suppression of boll weevil (Coleoptera: curculionidae) populations in Nicaragua. Crop Protection 7:168-176.

33. Todd, J. W. and F. W. Schumann. 1988. Combination of insecticide applications with trap crops of early maturing soybean and southern peas for population management of *Nezara viridula* in Soybean (Hemiptera: Pentatomidae). J. Entomol. Sci. 23:192-199.