

Push-Pull Strategy for Insect Pest Control

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SUMMARY

Push pull strategy implies the behavioural manipulations of insect pests and their natural enemies by using the behaviour modifying stimuli which makes the main crop comparably unattractive and unpalatable to the pests while diverting them towards the more attractive sources by implying use of non-toxic components for pest population reduction with reduced pesticide input. This mechanism is established by the use of exploiting semiochemicals which deter the pests from the main crop (“push”) and attract them into trap crops (“pull”). Intercropping or companion cropping is done for semiochemicals delivery which mask host stimuli and act as a repellent and deterrent.

INTRODUCTION

Push pull strategy is an important tool in integrated pest management for sustainable agriculture which involves the behaviour manipulation of insect pests and their natural enemies by using behaviour modifying stimuli which makes the main crop comparatively unattractive and unpalatable towards the key insect of the location while diverting them towards the more attractive sources from where they are killed by pesticidal application (Bhattacharyya, 2017). Push pull strategy of integrated pest management is a newly emerged pest control method which uses non-toxic components for pest population reduction with reduced pesticide input. The push pull effect is established by the use of exploiting semiochemicals which deter the pests from the main crop i.e. repellent plant “push” and attract them into trap crops or attractant plant “pull”. The insects attract towards what appears to be a tastier meal. These grass provide the “pull” in the push-pull” strategy. The “push” is provided by the plants that emit repellent chemical called kairomones which repel stem borer moths and drives them away from the main crop i.e. maize or sorghum.

Principle of Push-Pull Strategy

Push-pull strategy, pests are repelled or deterred away from the main crop (push) by using stimuli that masks host appearance or are repellent or deterrent. Pests are simultaneously attracted (pull) using highly apparent and attractive stimuli to other areas such as traps or trap crops where they are concentrated, facilitating their control.

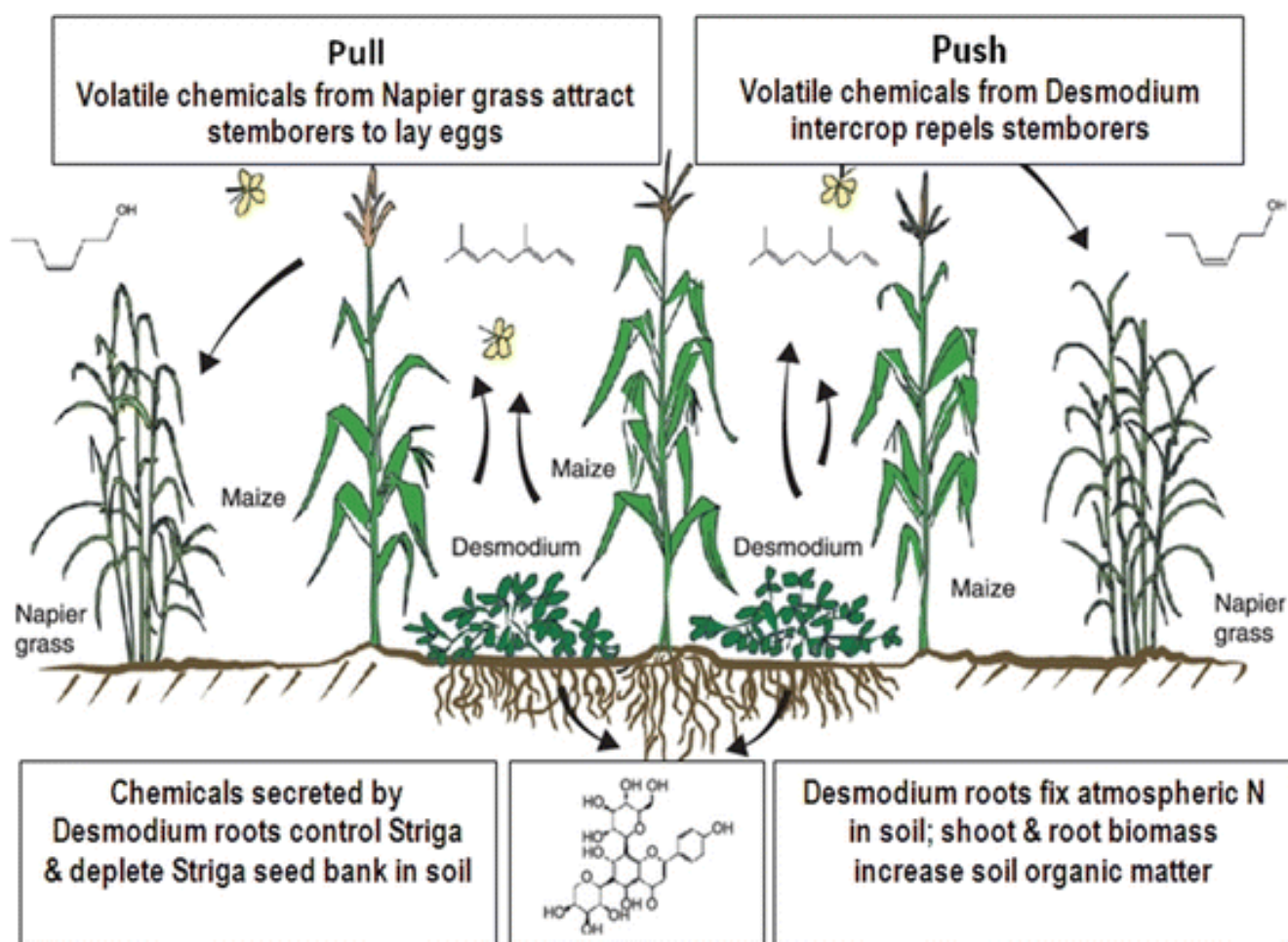
Institutional Innovation

Push-pull technology (www.push-pull.net) is a novel cropping system developed by the International Centre of Insect Physiology and Ecology (ICIPE) in collaboration with Rothamsted Research (UK)(www.rothamsted.ac.uk/), Kenyan Agricultural Research Institute (KARI) (www.kari.org) and other national partners for integrated pest, weed and soil management in cereal-livestock-based farming systems. It involves attracting stemborers with Napier grass (*Pennisetum purpureum*), planted on the border of the field as a trap plant (pull), while driving them away from the main crop using a repellent intercrop (push) such as desmodium forage legumes (*Desmodium spp.*). Chemicals released by desmodium roots cause abortive germination of the parasitic striga weed, providing effective control of this noxious weed. The companion plants provide high-value animal fodder, facilitating milk production and diversifying farmers’ income sources. Furthermore, soil fertility is improved and soil degradation prevented. The technology is appropriate to small holder farmers as it effectively addresses the major production constraints, and is economical as it is based on locally available plants, not expensive external inputs. It also fits well with traditional mixed cropping systems in Africa.

Mechanism Push-Pull Strategy

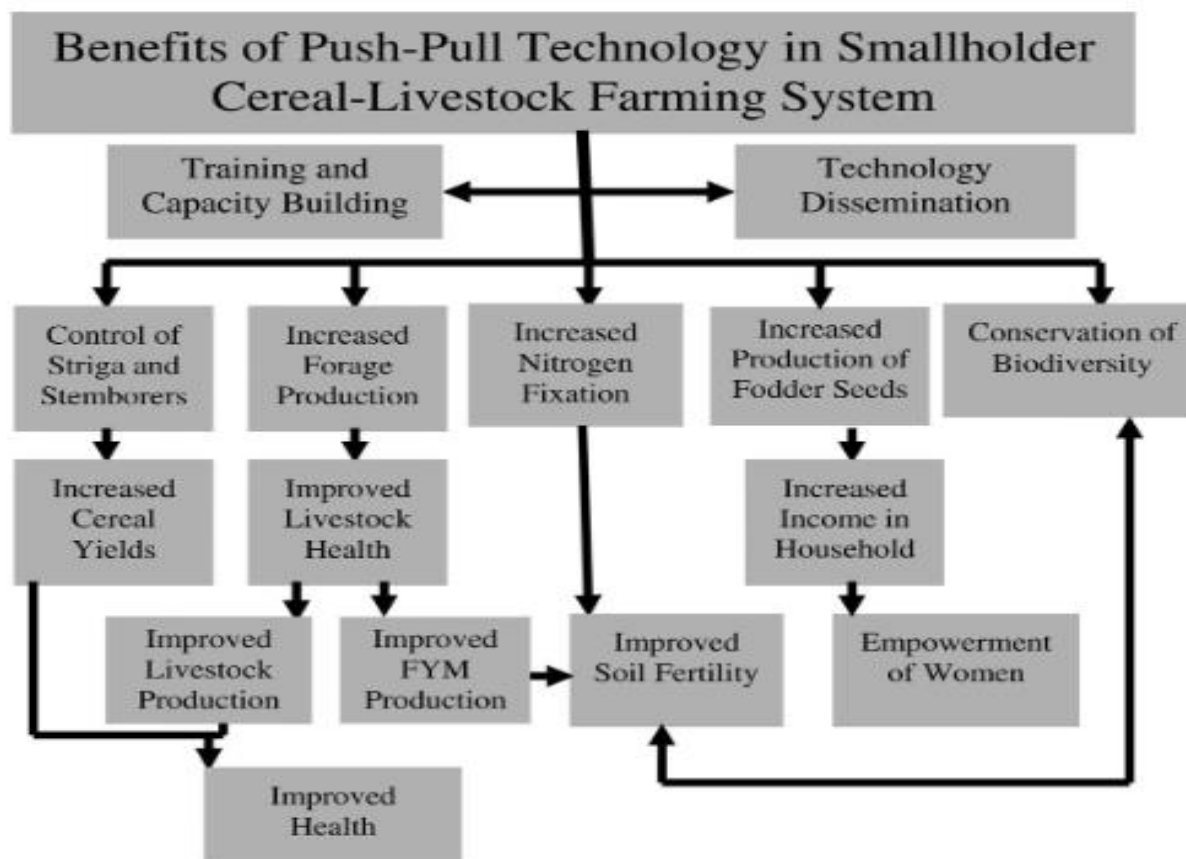
The push-pull strategy undertakes a holistic approach in exploiting chemical ecology and agrobiodiversity. It involves the behavioural manipulations of insect pests and their natural enemies by the use of behaviour modifying stimuli which makes the main crop comparatively unattractive and unpalatable to the pests

(push) while diverting them to the more attractive sources (pull) from where the pests are subsequently removed. It involves release of attractive volatiles from the trap plants and repellent volatiles from the intercrops. Push-pull strategies maximize efficacy of behaviour manipulating stimuli through the additive and synergistic effects of integrating their use. It uses behaviour modifying stimuli to manipulate the distribution and abundance of stemborers and beneficial insects for management of stemborers. It is based on understanding of chemical ecology, agrobiodiversity, plant-plant and insect-plant interactions and involves intercropping a cereal crop with a repellent intercrop. Gravid stemborer females are repelled from the main crop and are simultaneously attracted to the trap crop. Plants that have been identified as effective in the push-pull includes napier grass, sudan grass, molasses grass and desmodium. Napier grass and Sudan grass are used as trap plants whereas molasses grass and desmodium repel ovipositing stemborers. Molasses grass when intercropped with maize, not only reduced infestation of the maize by stemborers but also increased stemborer parasitism by a natural enemy, *Cotesia sesamiae*. The strategy is a useful tool for integrated pest management programs reducing pesticide input.



Advantages of Push-Pull Strategy

- Increased efficiency of integrated pest management by improving potential for use of antifeedant and oviposition deterrents and reduced the application of synthetic chemicals in the agroecosystem.
- Certain intercrops and trap crops used in this strategy may also help in the control of weeds by dramatic reduction of the weed seed bank in the soil due to allelopathic effect.
- Attract both adult and immature stage of insect pests.
- Reduced the pest population at certain level and subsequent yield increase.
- Increased fodder production which leads to improved dairy and FYM production.
- Nitrogen fixation and reduced soil erosion.



Limitation of Push-Pull Strategy

- Limited specificity.
- Less effective to compete with abundant surrounding odour sources for attraction.
- Limitation to development:
 - a. Development of semiochemical component.
 - b. Understanding of behavioural and chemical ecology of the host pests.
 - c. Insufficient knowledge, control breakdown.
- Limitation to adoption:
 - a. Integrated approach to pest control which is very complex.
 - b. More insecticide and low knowledge of biological control agent.
 - c. Napier grass, grown as trap plants was shown to suffer from Napier grass stunting disease. According to one source, the Napier stunt disease was caused by 16SrIII group of phytoplasma whose vector could not be identified

CONCLUSION

The strategy push-pull is a nontoxic useful tool for sustainable pest management programme reducing pesticide input. It is mainly concerned with the behavioural manipulation of the pests and natural enemies whereby several trap and companion crops are grown with the main crop with several eco-friendly approaches of pest management like use of pheromones and botanical pesticides. These eco-friendly approaches would however help in the conservation of natural enemies which would bring down the pest load below ETL and eventually lower broad spectrum pesticides use which brings pest resurgence and pest resistant problems.

REFERENCES

Bhattacharyya, M. (2017). The push-pull strategy: A new approach to the eco-friendly method of pest management in agriculture. *Journal of Entomology and Zoology Studies*, 5(3), 604-607.