e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:01/January-2023 Impact Factor- 6.752 www.irjmets.com

ROLE OF ANTS IN SUSTAINABLE AGRICULTURE

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DOI: https://www.doi.org/10.56726/IRJMETS33191

ABSTRACT

The present brief review article is planned to understand the role of ant in agriculture. The agricultural strengthening is called 'green revolution' has intensely improved crop yields, but it is doubtful whether exhaustive practices are maintainable over the lengthy period. Earthworms are well recognized to improve soil health in mutually native and agricultural systems and are considered to be ecosystem engineers. Earthworms are restricted in their circulation to wetter and cooler habitats. Ants seem to substitute earthworms as soil eco-system engineers in drier and hotter environments. Numerous research reports have revealed that ants benefit to produce good soil structure, stimulus ventilation, water permeation and nutrient cycling in natural eco-systems. Though notwithstanding the superficial resemblance in practical roles in soil that ants have with earthworms, their possible use in exhaustive agriculture in drier and hotter surroundings has been basically unnoticed.

Keywords: Ants; Sustainable Agriculture; Agro-Ecosystems; Crop Yield

I. INTRODUCTION

Nature's functioning depends upon microbial interactions among plants and animals, and their ability to adapt to environmental changes. Their relationship with each other and the environment relies on communication (signal exchanges), and the ability to assume dormancy under unfavorable conditions. The essential role ecosystems have is to provide services to humankind such as nutrient cycling, pest control, pollination, quality of life, and hydrological, atmospheric and climatic regulation. Among the macronutrients, nitrogen, a most unusual element, attracts a lot of interest because it interacts in various ways with ecosystem functioning. Along its biogeochemical pathway nitrogen is reduced to NH^{+}_{4}, and oxidized into NO, NO^{-}_{2}, N_2O and NO^{-}_{3}. It reaches by leaching, wind, erosion, or transport by animals any part of the Earth's system, no matter where it is introduced. The N cascade is interrupted only when nitrogen is incorporated into biomass, humus and clay minerals. The manifold nitrogen links to the environment make an effective control on farm and landscape level difficult. Instead, N_2 nitrogen increasingly returns as NH_3, NOx and N_2O into the atmosphere, where visibility decreases, the stratospheric ozone is depleted, and global warming and precipitation of acidity increase. Acidity in soils changes the biodiversity and an alternative soil C/N management is required. This review portrays the self-organized living together predominantly of harvester, leaf cutter and honeydew-sucking ants, with their nest functioning based on organic imports high in carbon but low in nitrogen; and it is asked whether a reduction of soil carbon decline and greenhouse gas emissions could be approached by adapting their C/N management[1-4].

II. ANTS AS TOOLS IN SUSTAINABLE AGRICULTURE

In a world with a rapidly expanding population of increasingly wealthier people, there is growing demand for food and a simultaneous need for higher environmental sustainability Being organized as superorganisms, many ant species hold desirable characteristics unshared by most other beneficials.

Firstly, ants are extremely abundant in most ecosystems. With such abundance, any fruitful interaction derived from this taxon holds a high potential. Secondly, ants possess features making them suitable for biological control programs. Using recruitment systems based on trial laying, tandem running and alarm pheromones, ants recruit nest mates to high prey densities. Consequently, they show fast numerical responses when pest populations escalate. Recruitment behavior can, moreover, be utilized to attract ants to focal points where their services are most needed Most ant species are polyphagous, cooperative and often with polymorphic worker forces, enabling them to deploy a wide range of prey types. They may exert pressure on several pest species and life stages; small workers may handle eggs, Whereas larger worker may engage larger size individual. Ants are able to store protein in the form of trophic eggs and brood that may be cannibalized, making their colonies stable and a predictable service with low management costs. With these attributes, ants have started to attract attentions control agents against a number of pests in different agricultural systems; especially, work on weaver ants. Pragmatic work on these ants provides some of the first examples of well-documented cost-efficient conservation biological control programs, where conservation leads not only to more natural enemies, but also to cascading effects ultimately leading to increased yields. weaver ants are unlikely to be unique in their abilities to provide effective pest protection. Of the almost 13000 described ant species, many other species are likely to hold similar properties. Figure 1 shows the leaf-cutter ants.

Figure 1. Leaf-cutter Ants

III. MANAGING WEAVER ANTS

Weaver ants are arboreal and build woven leaf nests in canopies of trees and shrubs and may control pest insects in plantations and forestry. In brief, measures to manage the ants to increase their density beyond natural levels (i) modifying or limiting use of insecticides, (ii) transplanting ant colonies into plantations, (iii) providing intra-colony host tree connections (with rope, poles or lianas), (iv) pruning trees to reduce fighting between neighbouring colonies, (v) providing supplementary ant feeding (sugar, water and sometimes protein) during parts of the season, (vi) providing artificial nesting sites to the ants. It is a 'low-tech, low cost' methodology. What is needed is know-how on weaver ant management, a piece of rope or liana and a pruner. This allows even the most resource poor farmers and growers to adopt the technology, given they are informed about its existence and trained in its use [5].

IV. ANTS INCREASE CROP YIELD

The agricultural intensification known as the green revolution has dramatically increased crop yields, but it is questionable whether intensive practices are sustainable in the long term. There are the increasing costs of petroleum-based products such as herbicides, pesticides, fertilizers and energy inputs, and increasing costs of water. In addition, agricultural intensification has caused environmental degradation from loss of biodiversity due to monoculture of agriculturally important species, loss and fragmentation of habitat, chemical inputs into waterways and deterioration of soil health One approach to developing more sustainable agriculture is to maintain or restore natural ecosystem services that reduce dependence on human inputs to agricultural systems. Examples of ecosystem services used in agriculture are dung burial, pollination and predation or parasitism, to reduce insect herbivores by natural enemies or beneficial insects. Earthworms are well known to improve soil health in both native and agricultural systems and are considered to be eco-system engineers. Earthworms affect soil structure by increasing porosity and decreasing bulk density, both of which lead to greater water infiltration into the soil, and they can also increase the supply of nitrogen and other nutrients, but their role in intensive agricultural production systems is limited by excessive soil disturbance. Earthworms are limited in their distribution to wetter and cooler habitats. Ants appear to replace earthworms as

soil ecosystem engineers in drier and hotter habitats. Various studies have shown that ants and termites help to create soil structure, influence aeration, water infiltration and nutrient cycling in natural ecosystems Furthermore, despite widespread acknowledgement of the importance of biodiversity on ecosystem services and small-scale demonstration of the link between soil faunal activity and plant growth in microcosms there has been no experimental field-scale demonstration of a direct positive relationship between a rich soil macrofauna and enhanced crop yield in sustainable agriculture. An experiment was conducted on a farm with some conservation agriculture management and, therefore, diverse soil fauna. In this study they chose this farm partly because it lies near the arid extreme of wheat production in Australia, and partly because earthworms are absent. This study excluded ants and termites and measured the impacts of ant and termite activity and crop yield over 3 years; we also tilled to mimic physical weed control to determine its effect on ant and termite activity. The two major mechanisms by which these insects might affect crop yield: soil macropores, the channels through soil that increase water infiltration and soil nutrients, as soil fauna transform these nutrients from organic to mineral forms which can be assimilated by plants and this study come to the conclusion that the exclusion treatment would reduce soil tunnels, and hence reduce soil moisture infiltration during rainfall events, and also reduce mineral soil nutrients over time. We found that ants and termites raise crop yield by increasing water infiltration into the soil through their tunnels and by increasing the supply of soil mineral nitrogen. Results from this study have provided the first demonstration that the presence of ants and termites raise crop yield by contributing valuable ecosystem services, and hence may become a new tool for sustainable management of production landscapes in drier climates. As the arid conditions of the experiment mimic future temperature and rainfall conditions of many of the major wheat production areas predicted under climate change, these results may be pertinent for climate adaptation [6].

V. ANTS AS A KEY ELEMENTS IN FRUIT AGRO-ECOSYSTEMS

Ants provide ecosystem services in agro-systems by playing a major role in plant pollination, soil bioturbation, bioindication, and the regulation of crop-damaging insects. Over recent decades, there have been numerous studies in ant ecology and the focus on tree cropping systems has given added importance to ant ecology knowledge. The only missing point in this knowledge is the reasons underlying difference between the positive and negative effects of ants in tree cropping systems. Although ants are small and seemingly insignificant creatures as individuals, collectively, they are one of the dominant groups of the planet's animal biomass, accounting for around 10% They play a fundamental role in agro-ecosystem functioning and provide multiple services such as biological control , plant pollination, soil bioturbation , and bioindication , along with providing a diagnostic tool in orchards or animal and plant biodiversity conservation .That potential has been studied in the genus *Oecophylla*, whose ability to control a wide range of insect pests has been demonstrated on crops such as citrus, mango or cashew in Africa, as well as citrus in tropical Asia and Australia. Other genera such as Azteca, Ectatomma or Wasmania also have been reported to be effective biological control agents. Ants also play an important role in plant pollination and soil bioturbation. Their effects on soil through aeration and chemical modifications as well as their relations with the other biotic components of agro-ecosystems such as plants, microorganisms and the other organisms in the soil are particularly significant. Agro-ecology is defined as being an integrative discipline that brings about the synergism of agricultural, sociological and economic approaches. For fruit agro-ecosystems, it is a matter of knowing whether a satisfactory compromise can be found between the benefits of the presence of weaver ants (predation of pests) and their negative effect on pollination. The fact is that it is very difficult to predict: (i) the effect of weaver ants on fruit tree pollinators; and (ii) the impact of the drop in pollinator access to flowers on tree yields. Indeed, very few data are available on fruit tree pollinators in the Tropics. Nevertheless, mango, cashew and Citrus mainly seem to be dependent on pollination by insects. However, very few studies have been undertaken on the African continent. Consequently, the impact of *O.* longinoda ants on fruit tree pollination in African orchards, when they are used as a biological control agent, calls for further studies, as is currently the case in Benin [7].

VI. CONCLUSIONS

In the summary, it is concluded that,

1. Ecological processes are the products of multifaceted interactions and the importance of crop, pest, pollinator, and predator framework for when these processes may be gained.

2. Weaver ants are source of dropping possessions to subordinate trophic levels, declining pest inhabitants and their impairment, consecutively consequential in higher crop yields.

3. Reaper and leaf cutter ants retain attackers low-slung by antibiotics and by introducing organic material, little in nitrogen but rich in carbon, by loading nitrogen momentarily in the cuticle and by possessing the shell C/N ratio in service of the electron donator.

ACKNOWLEDGEMENTS

Authors are very much thankful to Principal, Smt. Radhabai Sarda Arts, Commerce & Science College, Anjangaon Surji, Dist. Amravati, Maharashtra – 444705 for providing necessary academic help.

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