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BIOLOGICAL CONTROL OF LOCUSTS: ENVIRONMENTAL ISSUES

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ABSTRACT:- Control of locusts has traditionally relied on synthetic insecticides, and for emergency situations this is unlikely to change. However, a growing awareness of the environmental issues associated with acridid control as well as the high costs of emergency control are expanding the demand for biological control. In particular, preventive, integrated control strategies with early interventions will reduce the financial and environmental costs associated with large-scale plague treatments. The recent development of effective oil formulations of Metarhizium anisopliae spores in Africa, Australia, and Brazil opens new possibilities for environmentally safe control operations. Metarhizium biopesticide kills 70%–90% of treated locusts within 14–20 days, with no measurable impact on nontarget organisms. An integrated pest management strategy, with an emphasis on the use of Metarhizium, that incorporates rational use of chemical pesticides with biological options such as the microsporidian Nosema locustae and the hymenopteran egg parasitoids Scelio spp., has become a realistic option.

KEYWORDS:- Locusts, environmental, plague and control.

INTRODUCTION:-

Locusts (Orthoptera: Acrididae) represent perhaps the most conspicuous of all insect pests and are abundant insects of dry grassland and desert. When populations of these insects build up, certain species exhibit gregarious and migratory behavior, leading to the formation of spectacular swarms. From their mention in the Bible to current media reports, these locust plagues attract public attention in a way that no other insects do; the image of a flying swarm of locusts from the desert descending onto crops never fails to stir the human conscience. In the majority of cases, national authorities have adequate capacity to conduct preventive control measures, controlling outbreaks at an early stage through the use of chemical pesticides. In countries such as Argentina, Australia, China, Niger, and South Africa, populations of locusts and grasshoppers are monitored and treated as soon as outbreaks threaten. When pests cross national borders, internationally coordinated operations are necessary; we discuss this more complex situation in relation to the desert locust (*Schistocerca gregaria* Forsk et al) below. Plagues develop only when control efforts break down, or political or natural disasters prevent access to breeding areas, and interventions do not start early enough. Control failures and plague development have occurred with the desert locust in the Red Sea basin in 1986 and 1992 (Showler AT, Potter CS. 1991, Showler AT. 1995), with the migratory locust *Locusta migratoria capito* (Sauss) in Madagascar in 1995 (World Bank. 1998), and with the Italian locust *Calliptamus italicus* L. in Kazakhstan in 1997 (World Bank. 1998). Once plagues develop, curative insecticide applications become necessary over wide areas, with associated financial and environmental costs that are far in excess of the cost of preventive control.

In this review we give an overview of the current status of control options against locusts and grasshoppers and the increase in environmental awareness and political issues associated with locust control. We examine developments in biological control over the last decade, with a particular focus on the development of biological pesticides based on oil formulations of fungal spores. Finally, we discuss how biological control options could be incorporated into integrated pest management (IPM) strategies, and what further research and development work is necessary to implement such IPM strategies.

MATERIAL AND METHODS:-

Considerations of acridid population dynamics are useful in evaluating the potential for biological control. Classical biological control refers to an inoculative introduction of an agent not previously present; in cases where this represents a new association between an effective biological control agent and a pest, it is referred to as a neoclassical biological control (Lockwood JA, Ewen AB. 1997). Inoculative augmentation refers to the application of an indigenous agent to enhance subsequent build up in the bio control agent population, whereas in un dative augmentation refers to the mass application of an agent with the primary objective of high initial kill. In both economic and ecological terms, a classical biological control agent that becomes established and exerts a controlling influence on a pest over an indefinite time period is the ideal control agent.

Many of these biocontrol approaches are applicable to locust and grasshopper control but their potential has been underestimated in the past because of the emphasis on chemical control. Most grasshoppers and locusts are indigenous to their particular environment, so the prospects for classical biological control would not Annu. Similarly, rates of acridid population growth and movement appear to exceed those of their natural enemies, and normally the impact of pathogens on populations is minimal. However, the examination of these contraindications in more detail reveals several windows of opportunity. The egg stage is vulnerable to parasitoid attack. Given the high rates of efficacy of some oligophagous *Scelio* spp. in Australia (Baker GL, Dysart RJ, Pigott RG. 1996), there may be potential for new associations that have not been adequately explored; we discuss this possibility further below. Arthropod natural enemies of the mobile stages of acridids only build up late in the plague cycle. If the pest habitat has been treated with chemical pesticides, this buildup may be further delayed. It is possible that treatment with a more selective control agent would permit a more rapid buildup in the natural enemy population. Both in this context, and in their own right as stand-alone pest control agents, we can consider the use of pest-specific microorganisms (entomopathogens) as inundative, inoculative, and classical biocontrol agents.

The use of entomopathogens as control agents is referred to as microbial control; when the entomopathogenic microbe is mass-produced and formulated, we can refer to it as a biological pesticide (biopesticide) or mycopesticide (when the microbe is a fungus). An emerging theoretical framework for the role of entomopathogens as biological pesticides in IPM (Gelernter WD, Lomer CJ. 2000, Thomas MB. 1999, Thomas MB, Wood SN, Lomer CJ. 1995) leads us to suppose that, if we could find ways to manipulate pathogen populations, we could have a lasting impact on pest populations and exploit their specificity to allow a full role for arthropod natural enemies, all for a minimal environmental impact.

Most acridids appear to be quite susceptible to pathogens and normally evade them by preferring dry habitats and moving on to new habitats. Goettel & Johnson (Goettel MS, Johnson DL, eds. 1997) provide an overview of the pathogens that affect acridids, including bacteria, viruses, nematodes, microsporidia, and fungi. The first microbial control agent developed for acridid control was *Nosema locustae* Canning (phylum Microspora: Microsporidia: Microsporidae; Johnson DL. 1997); but a demand for more rapid speed of kill led to the development of fungi capable of penetrating insect cuticle.

RESULT & DISCUSSION:-

Environmental issues arising from the standard use of chemical pesticides against locusts and grasshoppers include the impact on operators, other people, livestock, birds, other terrestrial vertebrates (especially lizards), aquatic organisms (fish and invertebrates), and terrestrial arthropods, including the natural enemies of locusts and grasshoppers, as well as pollution issues, contamination of groundwater and wells, and disposal of surplus pesticide stocks (Food and Agriculture Organization. 1997).

Several publications deal with the state of our knowledge when the alarm was first raised (Berger L and Associates Inc. 1991, Ritchie JM, Dobson H. 1995), and much useful research has been conducted since then. Murphy et al (Murphy CF, Jepson PC, Croft BA. 1994) reviewed the toxicities of commonly used pesticides and found that in 45%–55% of the records, the chemicals gave mortality rates >90% in nontarget species. Initially, desert environments were viewed as fragile per se (Matteson PC. 1992); more recently, attempts have been made to define which particular environments are most at risk. In general, ephemeral aquatic habitats are especially vulnerable, particularly if used by migratory birds as feeding and resting areas. Few attempts have been made to quantify the external costs associated with grasshopper and locust control; (Houndekon V, DeGroote H. 1998) estimated veterinary, health, and disposal costs and found a small but significant value for these externalities.

Numerous studies relate the negative impact of chemical pesticides on non-target organisms. With the available information on the selectivity of chemical pesticides and the areas particularly at risk, it should be possible to design pesticide use so that environmental damage is minimized while control objectives are achieved. For instance, Martin et al (Martin PA, Johnson DL, Forsyth DJ, Hill BD. 1998) investigated the impact of treating grassland with the pyrethroid deltamethrin to control grasshoppers on the availability of insects, primarily grasshoppers, as a food source for grassland songbirds. Levels of control of 90% were economically effective while allowing persistence of sufficient numbers of grasshoppers to allow survival of nestlings and successful fledging. Similarly, the use of low levels of insecticides with known low avian toxicity, such as carbaryl in wheat bran bait (Johnson DL, Henry JE. 1987), has been shown to result in reductions of 70%, which allows survival of post treatment populations of 1–5 grasshoppers per square meter. Such levels are well below the economic threshold, but are above the levels required for survival of insectivorous grassland birds.

A slightly different approach that focuses on reduction of the total area treated is proposed by Schell & Lockwood (Schell SP, Lockwood JA. 1997). The long persistence of both insect growth regulator chemicals and fipronil means that they can be used to treat barrier strips in much the same way as dieldrin was used. In this way, the total dose per hectare is much reduced, as is the impact on nontarget organisms (Balan¸ca G et,al, 1997, Tingle CCD et. al 1997). Despite these advances, there remains scope for the use of biological control.

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