BRIEFING ON LOCUSTS N°3 E

SOME ALTERNATIVES TO COMBAT LOCUSTS IN THE SAHEL

Metarhizium

Neem extract

Phenylacetonitrile (PAN)

Insect's growth regulating hormones (IGR)

ABSTRACT

The widespread reliance of locust control exclusively on chemical pesticides has significant health, environmental and economic impacts, in countries with limited capacity to quantify and manage them. As well as the devastating and unquantifiable toll on communities, the direct costs of the last locust invasion in West Africa are estimated to exceed $ 400 millions.

Non-chemical products based on biological control and IPM are available and have been demonstrated to work in trial and field conditions. However, their uptake is severely limited, partly as a result of lack of knowledge and experience. This briefing describes the most promising technologies and seeks to stimulate a transition to sustainable locust control by raising awareness widely of the emerging solutions.

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Introduction

Locust plagues are recurrent in the Sahel, causing considerable damage to agricultural production and vegetation cover. The last locust plague took place in 2003 – 2005. It affected several countries in West Africa (Burkina Faso, Gambia, Mali, Mauritania, Niger, Senegal and Chad) and in North Africa (Algeria, Libya, Morocco and Tunisia) (PAN Africa, 2006). The total areas affected amounted to over 12. 9 million ha (Brader & al., 2006), causing suffering to about 8 million people at various degrees in the Sahel (Brader and al 2006). Mali and Senegal are among the worst affected countries. To face this invasion, the countries have mobilized significant human and material resources, including to treat nearly 12. 9 million hectares with 13 million liters of pesticides (Brader and al. 2006). The chemical pesticides used are not specific to locusts, but are also toxic to non target organisms. In Senegal, the indirect cost to human health and the environment from the excessive use of the products has been estimated at €5.2 million (Leach and al., 2008), making the adoption of alternative methods is imperative for health and environmental reasons, but also economic reasons.

Metarhizium and Neem extracts have been used in the fight against locusts. Other alternative methods of control are being developed.

FAO

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FAO

Biological control of locusts: combine efficiency and environmental friendliness

METARHIZIUM

Metarhizium anisopliae var acridum is a fungus used in "Green Muscle", a biopesticide developed by the Biological Control Center of the International Institute for Tropical Agriculture in Cotonou (Benin) (FAO 2006). In Africa, "Green Muscle" is currently manufactured in South Africa and Senegal. African climatic conditions are generally favorable to the development of the fungus, whose biological and physical properties make it an ideal candidate for biological control against desert locusts. Metarhizium has been widely used in Australia with some interesting results (Spurgin, 2007).

Oil formulation to mix with diesel oil

Dry spores to mix with oil and petroleum (or diesel oil)

Effects on the locust

The main effect of Metarhizium is the disruption of the locust's moult.Upon entering the insect, the fungus secretes microbial enzymes (proteases and chitinases) that inhibit the formation of the cuticle by inducing an abnormal and lethal exuviation (rejection of the old shell) for the locust (Smagghe and al., 1997).

Unlike chemical pesticides, Metarhizium has no knockdown effect and does not kill quickly. Locusts take 6 to 10 days to die. They are gradually incapacitated during this period, with reduced ability to eat and to move.

Treatments performed in the field showed that Metarhizium acts in 10 days. All stages of the locust are sensitive to the product (Zakaria and al, 2003).

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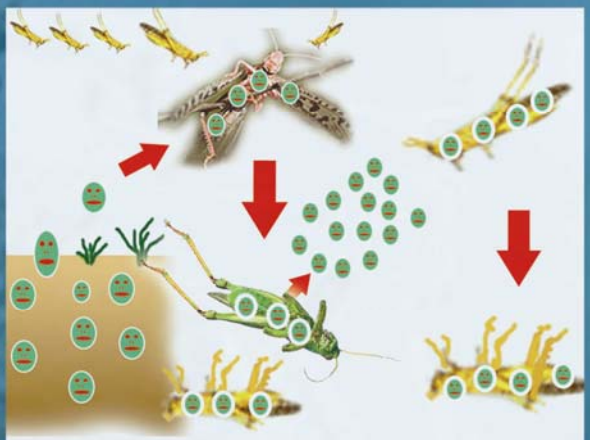
Benefits

The fungus is adapted to hot climates (35°) .
In the field, insect mortality can reach 100 % on the 22nd day after treatment (Seiglaff et al, 1996) ;
The commercial product (Green Muscle) is similar to chemical products and so can be used as such ;
The spores are harmless in other forms of life (Greathead and al, 1994) ;
The fungus can survive up to 45 days after application without negative effects on non target fauna. (LUBILOSA, 1996) ;
It presents no risks to human health and the environment.

Limitations

Metarhizium takes several days to kill the locusts.
Commercial products are relatively expensive.
Metarhizium, in liquid form and ready for use (Green Muscle), has a very short shelf life.

Mode d'action du *Metarhizium*



Metarhizium anisopliae var. *acridum* infects the locust by contact and not by ingestion, and develops in each individual forming spores that infect other insects. It eats nutrients of the insect that eventually dies.

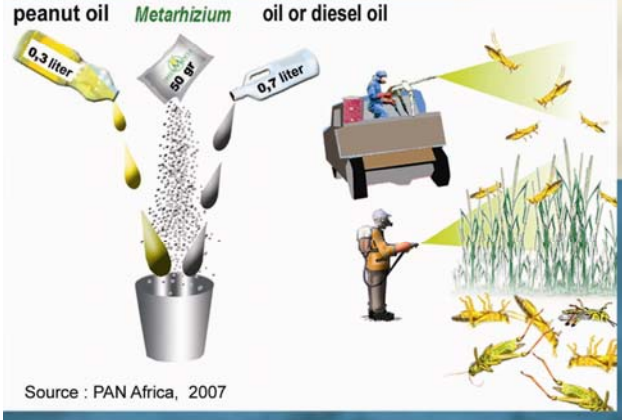
Source : PAN Africa, 2007

Experience using Metarhizium

Although effective on all larval stages as well as on the winged, the fungus produces better results in preventive control. Spores can be spread on the hopper bands and will have a rapid lethal effect. In case of invasion, the product can be used for 25 to 50 g of spores/ha. In April 2008, Green Muscle (GM) was used in Mauritania as part of routine control operations against the desert locust, on an area of 40 ha and with good results. In September of that year, in Senegal, about 8000 ha were treated with GM against another locust Oedaleus senegalensis. Preliminary results show a good efficacy at a dose of 25 g/ha (FAO, 2009).

dropdata.org

Metarhizium spores



Source : PAN Africa, 2007

Applications are recommended in the morning and evening for a maximum effectiveness of the fungus. Treatment should take place early in the infestation. Locusts are infected within 24 hours, reaching 80-90% effectiveness in three weeks.

dailyparasite.blogspot.com

cricket infected with Metarhizium

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NEEM EXTRACTS, *AZADIRACHTA INDICA*

Neem tree grows easily in dry tropical climates (annual rainfall ranges from 150 to 1200 mm) and is very hardy and undemanding and is used in many IPM systems. A mature tree produces an average of 30 to 50 kg of fruit per year (Bertheau and al, 1981). All plants are used, but the fruits' pits contain the highest concentrations in active ingredients (Schwab, 1988).

The main active ingredients of the Neem are calamine, salannine, melantriol, nimbidine, nimbine and azadirachtine. The latter is primarily responsible for the biological activity of Neem (Kraus and al, 1985, quoted by ISRA/CNRA, 1997).

neem fruit

Effect on the locust

Neem extracts acts on the life cycle of the locust by:

- Perturbation of the moult (larval mortality) (Isman 1997) ;
- Inhibition of locomotion (Schmutterer, 1990) ;
- Repellent effect (Schumtterer, 1990) ;
- Effect on oviposition by serious disturbance of the locust hormonal metabolism (Nesh and al 1992).

jrdf.unblog.fr

swarm of locusts

Benefits

No toxic residues after soil application (Kerharo, 1974) .

Easy production at village level: 10 to 20 kg of dried, ground and diluted pits in water can serve to treat one hectar (Philogène and al, 2008).

Easiness to use oil and Neem oil cake (emulsion).

Azadirachtine has a systemic action in some crops. This greatly improves its efficiency (Isman, 1997).

Income generation in rural communities.

Limitations

Azadirachtine is quickly degraded by sunlight (half – life) of 20 h after application on a leaf surface) (Isman, 1997).

Commercial products (Neemex, Neem- Azal, etc.) are expensive.

Experience using Neem

- Oily barrier against larvae

Tests conducted in 1990 – 1991 during a period of remission of desert locust in Niger desert of Tamesna showed that Neem extracts resulted in 100 % mortality within 8 to 13 days in larvae (Nesh and al. 1992).
It will be possible to put in place barriers of Neem oil associated with Green Muscle. The application of oily barriers of 10 km2 requires 20 liters of Neem oil and 50 kg of spores per hectare (PAN, 2006)

- Fight against adult locusts

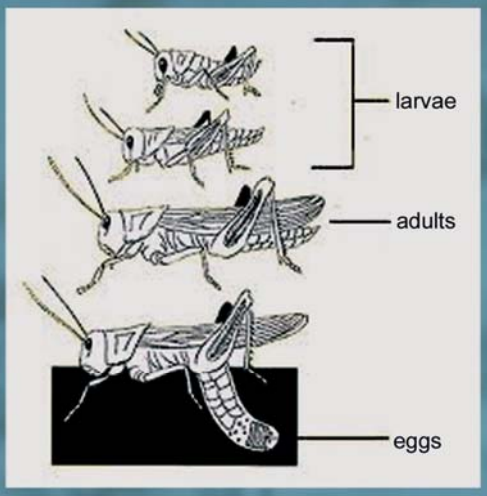
Neem is used as a repellent against adult locusts. The aqueous extracts of crushed leaves can be prepared on site by the villagers. Its repulsive efficiency can reach 100%. Given the persistence of the product (15 days), treatment with aqueous extracts must be renewed every 10 days.

The desert locust in gregarious phase on the left and in solitary phase on the right.

Other alternative methods

PHENYLACETONITRILE (PAN)

Phenylacetonitrile (PAN) is a synthetic hormone which acts on the herd instinct of adult males. Under the effect of PAN, the locusts recover their solitary behavior (FAO, 2006). In three field tests in Soudan and in Kenya it was shown that very low doses of PAN could disrupt the herd instinct, reduce locusts' feeding and movement as well as increase predation mortality (Van der Valk, 2007)



INSECTS' GROWTH REGULATING HORMONES (IGR)

Insects' growth regulating hormones (or IGR) block the ability of larvae to molt properly. They have no direct toxic effects on vertebrates. They remain effective after several weeks of application and are often used in the treatment called "in barrier". This type of treatment involves application of the product in narrow strips, perpendicular to the direction of the legions of larvae on. After crossing one or two barriers, the larvae absorb enough products that kill them during moulting (FAO, 2006). Active ingredients Diflubenzuron, Teflunenzuron and Triflumuron are IGR belonging to the group of benzoyl-ureas recommended by a directive of the FAO (FAO, 2005). They exist as commercial names: Dimilin OF6 (Diflubenzuron), Nomolt 50 ULV (Teflubenzuron) and Alsystin UL 050 (Triflumuron).

Conclusion

Significant progress has been made in research and the use of non alternative options in the fight against locusts. In Africa, adoption of these products remains relatively low. Chemicals seem more affordable, more accessible and easy to use. However, the effects of chemicals on health and the environment are not yet sufficiently documented and the actual costs of the impacts of chemicals are not well known. It is necessary to continue the efforts towards the development of non chemical alternatives. The African civil society organizations should engage in advocacy and lead policy makers to further support research and dissemination of alternative healthy and sustainable control method.

References

- Bissaad F. Z., Youcef M., Doumandji-Mitiche B. 2010. Effet d'un Champignon Entomopathogene *Metarhizium Anisopliae* Var. *Acridum* Sur la Cuticule De Criquet Pèlerin *(Schistocerca Gregaria, Forskål, 1775)*. *European Journal of Scientific Research*, Vol.45 No.1 (2010), pp.055-063.
- FAO, 2006. Lutte biologique contre le criquet pèlerin : Nouvelles armes face à un ennemi ancestral. FAO Salle de presse : http://www.fao.org/newsroom/fr/focus/2006/1000345/index.html.
- FAO, 2005. Directive – Essai à l'échelle opérationnelle de traitement en barrière de traitement en barrière avec les IGR – Version 2. Rapport FAO, Groupe Ravageurs Migrateurs, pp 4.
- Greathead. D.J., Kooyman C., Launois-Luong M.H. and Popov G.B. 1994. Les ennemis naturels des criquets du Sahel. Ed. Cirad/Prifas. Collection Acridologie Opérationnelle n°8. Montpellier. pp.147.
- Isman, 1995. Selection for resistance to azatirachtin in the green peach aphid, *Myzus persicae*. *Experientia, 51:* 831-833.
- ISRA/CNRA, 1997. Utilisation des feuilles de neem pour le contrôle des insectes ravageurs du niébé. Rapport ISRA, Bambey Sénégal, pp.8.
- Kerharo J. and Adam J.G. 1974 - La Pharmacopée sénégalaise traditionnelle, Vigot Frères, Paris, pp.1011 .
- Leach A.W., Mullié W.C., Mumford J.D. and Waibel H., 2008. Spatial and Historical Analysis of Pesticide Externalities in. Locust Control in Senegal- First Steps. FAO, Rome, pp 2.- PAN Africa 2006. Utilisation et gestion des pesticides dans la lutte anti- acridienne de 2004-2005 au Sénégal. Rapport PAN Africa/BM/PAN UK. pp. 32.
- Nesh O. and al., 1992. Les effets inhibiteurs de croissance et de biocides végétaux sur les larves de *Schistocerca gregaria*. Sahel PV infos n° 45 07/92, pp. 33.
- PAN Africa 2007. Méthode de lutte contre les criquets: le Metharhizium (Poster).
- PAN Africa, 2009. Lutte antiacridienne de 2004-2005 en Afrique de l'Ouest. Rapport PAN Africa/ASP/PAN UK. pp .18.
- Philogène B. J. R., Regnault-Roger C. et Vincent C., 2008. Biopesticides d'origine végétale : bilan et perspectives. Ed. TEC et DOC, Paris pp. 546.
- Schmutterer H., 1990. Properties and potential of natural pesticides from the neem tree, *Azadirachta indica, A. Rev. Entomol., 35:* 271-297.
- Schwab A., 1988. Lutte contre les nuisibles : la méthode naturelle. Rapport PAN Europe. pp. 33.
- Seiglaff D.H., Pereira R. M. and Capinera J.L., 1998. Microbila control of *Schistocerca Americana (Orthoptera : Acrididae)* by *Metarhizium flavoviride (Deuteromycotina)* : instar dependent mortality and efficacity of ultra low volume application under greenhouse conditions. *J. Econ. Entom.*. 91 (1) : 76-85.
- Smagghe G., Auda M., Van Laecke K., and Degheele D., 1997. Significance of penetration and metabolism on topical toxicity of deflubenzuron in *Spodoptera littoralis* and *Spodoptera exigua. Entomol. Exp. & Appl.* 82(3):255-260.
- Spurgin P., 2007. Leçons tirées de l'utilisation opérationnelle du Metarhizium en Australie. Rapport FAO, Atelier Internationa à Saly-Sénégal, pp. 4.
- Thiam A. et Ducommun G. 1993. Protection naturelle des végétaux en Afrique. *Série Etudes et Recherches n° 154-155-156.*, Enda Tiers-Monde, Dakar, Sénégal, pp. 212.
- Van Der Valk H., 2007. Exposé des connaissance sur l'efficacité du *Metarhizium anisopliae* var. *acridum* contre les locustes et les sautériaux. Rapport atelier international FAO à Saly, Sénégal. pp.4.
- Zakaria O. Sagna S. B. 2003. Lutte intégrée contre les sauteriaux et les locustes : importance du biopesticide Green Muscle. *Bulletin trimestriel d'information du Centre Régional AGRHYMET Vol. 5,3* Niamey, Niger, pp.16.

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