UNITED NATIONS DEVELOPMENT PROGRAMME

EMERGENCIES UNIT FOR ETHIOPIA (UNDP-EUE)

Armyworm Infestations in Ethiopia

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Armyworm biology and ecology

The African armyworm (Figure 1) is not actually a worm at all but rather the larval (caterpillar) stage of the night flying moth, *Spodoptera exempta.* The normal seasonal cycle of the armyworm begins with low-density breeding in the cool, coastal highland of Kenya and Tanzania. These small populations of the "solitary" phase do little or no crop damage but as the Inter Tropical Convergence Zone (ITCZ) begins moving northward the strong winds carry the moths into the interior highlands where the initial outbreaks can occur. It is in these highland areas that a peculiar and not well-understood biological mechanism may occur whereby the solitary pest transforms into the 40 times more active gregarious form. The voracious appetite of this gregarious form is such that a heavy infestation can consume rangeland grasses or wheat, barley, teff, maize, sorghum or finger miller faster than 400 head of cattle per hectare and vast areas can be decimated overnight.[1]

Figure 1: Armyworms (gregarious form)

After the caterpillars molt through six stages or instars over a 14-22 day period the larvae pupate in the soil to emerge as moths which can re-infest the same area or a completely different area several hundred kilometers downwind. As the moth (*Spodoptera exempta)* is nocturnal they often go unnoticed in their place of origin or can be easily swept up by the ITCZ winds and end up far downwind of the original areas of infestation (Figure 3). The moths do not form swarms like locusts but shifting winds can result in high concentrations of moths and, ultimately, very high concentrations of armyworms. After 7 to 14 days the female moths lay 100 to 200 eggs, usually on the underside of leaves and grasses. However, as the females lay eggs several times over a few days, each female can lay 800 to 1000 and as few as 30 moths could cause a serious outbreak of 15 million armyworms within two generations (two months). The eggs hatch after 2-5 days and the first instar or armyworm, under optimum conditions of temperature and humidity, can pass though all six instars in as little as two weeks.[2]

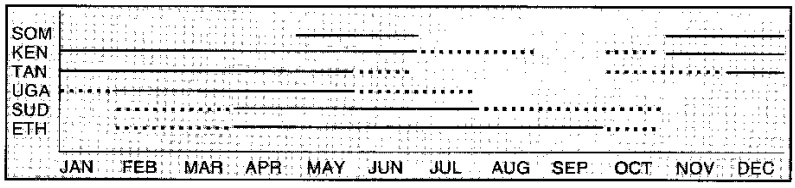


Figure 2: Periods of outbreaks regularly reported in East Africa

[1] *Armyworm Emergency Operations in Tigray*, Dr. Wolfgang Meinzingen, UN-EUE consultant and Dr. Robert Shank, UN-EUE Field Officer, UN-EUE, August 1994

[2] *A Guide to Migrant Pest Management in Africa*, Edited by W.F. Meinzingen, FAO, 1993

As noted above, the tracking of armyworm infestations is difficult as the moths are nocturnal and can move long distances with the seasonal winds. The most effective way of tracking/predicting armyworm infestations in through pheromone moth traps using a synthetic female hormone to attract males. The trapped male moths are counted each morning and when the count reaches 30 or more moths per day a light outbreak will be eminent within 7-10 days and the second generation outbreak (within about a month) can be severe. During severe outbreaks counts of several hundred moths are common. (In the 1994 armyworm outbreak in Ethiopia the pheromone trap at Asbe Teferi - West Hararghe - caught in excess of 1,000 moths every night between 23 and 29 May with a maximum catch of 1,923 moths in one night. This station continued to catch more than 100 moths per night until 7 July.[3])

Control measures

The very low densities but wide dispersal of armyworms in their initial breeding areas in Kenya and Tanzania make spraying operations uneconomical and, to a certain degree, control can only be initiated when there is a problem. The key to controlling armyworm infestations lies in the effective use of moth traps to predict infestations and, once infestations are noted, extremely quick interventions. The speed, wide dispersal and damage an armyworm infestation can cause are difficult to imagine and, once established, very difficult to control because there are sudden and urgent needs for control equipment and pesticides throughout a very large geographical area.

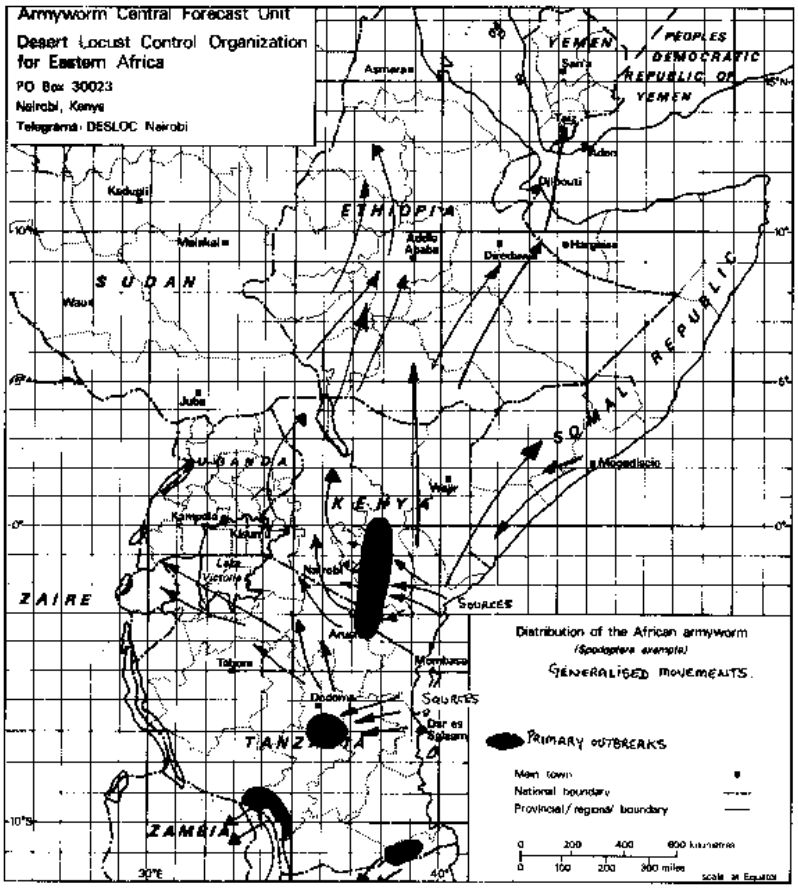


Figure 3: Schematic representation of movements from sources and primary outbreak areas

The 1994 infestation is a prime example of speed and wide dispersal of armyworm infestations and even aerial spraying operations in 1994 could not keep pace with the new infestations being reported on a daily basis.

Local farmers are well aware of the dangers of armyworm infestations and will usually take immediate action on their own initiative. Warning of possible infestations may come from the radio or sudden swarms of moths around cooking fires or candles. Traditional control measures are usually practiced on rangelands and include driving herds of cattle, sheep and/or goats back and forth across affected areas, dragging thorn bushes or beating the infested areas with sticks and branches, collecting larvae by hand (often used on crop land) or letting chickens feed on larvae.

[3] Armyworm Emergency Operations in Tigray, *op.cit.*

Although traditional control measures can be effective for small areas and pose no ecological dangers, they are limited value in areas of heavy infestation. (In 1994 the Western zone of Tigray reported 52,286 hectares affected of which 419 were controlled by traditional means involving 10,230 people while as much as 2,400 hectares were sprayed in a single day from the air.[4])

While aerial spraying can cover large tracks of land under the good conditions, effective spraying is logistically very complicated with extremely close coordination needed between ground staff to mark the affected areas, logistic support in terms of having the right amount and type of both aviation fuel and pesticides at the right airfield and regional authorities in terms of determining priorities. Aerial spraying can also be delayed or hampered by rain and fog, which if it continues for several days, may mean that spray materials and fuel will have to be re-positioned to another area. Lastly, aerial spraying can easily kill whole beehives, an important source of income for many rural families.

If equipment and pesticides can be in positioned quickly enough, the most effective control measure seems to be motorized backpack sprayers with ULV attachments.[5] Hand-held battery operated ULV sprayers have also been used extensively in Ethiopia but a large supply of batteries must be assured if the operation is to be successful. (In 1994 the Government of Ethiopia had to make an emergency purchased 50,000 dry cell batteries.[6] This purchase was in addition to extensive battery purchases made by CARE for control operations in Hararghe a month earlier.)

1994 Armyworm outbreak in Ethiopia

The 1994 armyworm outbreak in Ethiopia was the most serious in the experience of crop protection officials since 1984. From April to July, successive generations of moths migrated northward with the ITCZ to cause widespread and serious outbreaks on cereal crops in their early and most vulnerable stage of development. In 1994, as is previous cases of armyworm outbreaks, this outbreak followed a period of drought that exacerbated the economic impact of the armyworm damage.

Table 1: Armyworm infestation as of 29 June 1994

Region	Date of 1st Outbreak	Hectares Affected
Oromia	18/04/94	510,815
SNNPR	12/05/94	50,000
Somali Region	16/05/94	43,740
Region 13 (Harer)	20/05/94	10,225
Dire Dawa	23/05/94	4,675
Amhara	01/06/94	159,815
Tigray	06/06/94	40,402
Total		**834,446**

Source: Ministry of Agriculture, Plant Protection Agency
Note: by 22 July 170,083 hectares were affected in Tigray Region

The first armyworm outbreak in Ethiopia was reported in Borena Zone, Tetele Wereda on 18 April 1994, followed by further outbreaks in Eastern Hararghe and Bale Zones in early May 1994. By 3 June 1994 CARE Ethiopia reported heavy infestations in East and West Hararghe with particularly heavy infestations in maize and sorghum fields in Gursum, Babile and many weredas of Garamuleta. At that time a random count of an infested field gave 230 caterpillars per M^2.[7]

[4] *Ibid.*
[5] *Abstracts of Key Papers and Reports Prepared During Phase I of Project RAF/88/033: Strengthening DLCO-EA in the Management of Migrant Pests*, FAO, Rome, 1994.
[6] Minutes of the Armyworm Committee Meeting, 12 July 1994
[7] CARE Ethiopia fax of 3 June 1994

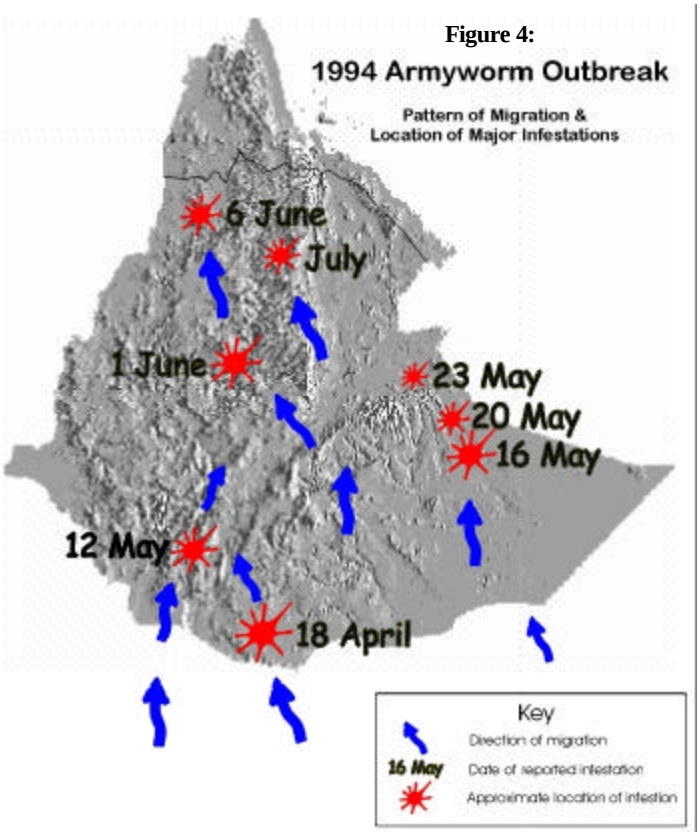
The 1994 outbreak followed the traditional pattern with infestations spreading to other areas of the country and by the end of June the Ministry of Agriculture reported 834,446 Hectares infested (Table 1). In addition to a large input from the Ministry of Agriculture for control operations, by the end of June DLCO had 6 Landrovers fitted with ULV equipment for spraying and one aircraft for spraying with several additional vehicles allotted for survey and support work.[8]

Table 2: UN-EUE Emergency Support for the MoA 1994 Armyworm Control Programme

Source of Funding	Amount (USD)	Activities
UNDP Emergency Fund (SPR)	$ 50,000	Consultant, aerial spraying & logistic support
Government of Switzerland	$ 38,000	Aerial spraying and logistic support
Government of Norway	$ 6,500	Logistic support
Government of Netherlands	$ 8,234	Logistic support

However as the infestations spread a major emergency control operation became necessary and various emergency task forces were established to assist the Government with control operations. In addition to direct contributions from several donors to the MoA and/or DLCO in cash and in kind, the UN-EUE, utilizing contributions from the UNDP Emergency Fund, and the Swiss, Norwegian and Netherlands governments, worked very closely with the Plant Protection Agency of the Ministry of Agriculture in organizing both emergency flights of aviation fuel and pesticides to the north as well as funding aerial spraying operations in Tigray. Total funds contributed to the UN-EUE intervention are shown in Table 2.

Figure 4:



On 10 July MoA reported 869,000 hectares affected with severe infestations in Tigray region with the first generation starting in early June and the second generation starting on 30 June with the level of infestation increasing in spite of ground and aerial spraying, which commenced on 28 June 1994.[9]

By 21 July the situation was under control in the Western Zone of Tigray but there were reports of new outbreaks in 13 weredas (15,284 hectares) of the Eastern Zone and 17 weredas (25,790 hectares) of the Southern Zone. In order to meet this new crisis, additional flights of pesticides and avgas were organized.

Aerial spraying operations concluded in early August and in spite of numerous logistic problems the overall operation was successful and estimated crop losses in Tigray were only about 2,500 hectares that had to be re-planted. However, in Oromia region the regional Agriculture Bureau reported armyworm damage much higher than in Tigray with losses of some 26,000 M/T of sorghum and 32,500 M/T of maize.[10]

[8] Minutes of the Desert Locust Meeting of 30 June 1994
[9] Minutes of Armyworm Committee Meeting of 12 July 1994
[10] *Emergency Assistance for Armyworm Control Operations in Ethiopia, UN-EUE Final Report to Donors*, UN-EUE November 1994.

The 1996 outbreak

The 1996 armyworm outbreak was much less severe than the 1994 outbreak but nonetheless almost 250,000 hectares in seven regions were affected, of which about 200,000 hectares were cropland. Chemical control measures through manual and motorized backpack sprayers were applied to about 93,000 hectares at a cost of roughly US $ 650,000. Aerial spraying was not used in 1996 because ground application was generally sufficient. Although this outbreak was successfully controlled and, unlike 1994, only about 1,000 hectares had to be replanted, the 1996 outbreak raised a number of issues concerning both the early warning system and control operations and if the rains had not been both timely and heavy the infestation might have been as severe and 1994. Of particular concern were problems with the pheromone moth traps (lack of pheromone capsules, traps not operational or not "counted" and delays in reporting moth counts). Control operations also faced problems because of lack of vehicles and communications with central offices, delays in the arrival of pesticides and sprayers and insufficient trained manpower.[11]

The 1999 outbreak

Large-scale armyworm outbreaks were reported in both Rwanda and Burundi in late April 1999 but initial estimates of 100,000 hectares of cropland and 400,000 hectares of pasture in Rwanda being infested were later significantly reduced. However, in spite of heavy rains and rapid interventions from the Government and FAO concerns remain that the next generation could re-infest many areas. In mid May the Government of Kenya issued and armyworm alert and by 19 May the Kenyan Minister of Agriculture reported that 100,000 hectares had been affected, including a large strip along the coast and the Rift Valley and that the infestation was the worst since 1984. At the same time armyworm infestations were also reported in Uganda while the joint WFP, USAID, EC and SCF-UK Food Security Assessment Unit for Somalia reported heavy infestations from Middle Juba, Lower Shabelle, Bakool and Hiran regions[12].

Table 3: Summary of Armyworm Outbreaks in Ethiopia as of 20 May 1999

Region	Zones	Weredas	PAs	Date First Reported	Infested areas		Pesticides Applied	
					Crop	Pasture	Litres	Kgs.
SNNPR	4	25	229	15/04/99	24,302	4,613	7,682	4,712
Oromia	5	41	424	18/04/99	125,396	97,487	14,069	2,103
Somali	5	N/A	N/A	03/05/99	69,000		1,307	218
Harar	N/A	N/A	17	06/05/99	6,000	N/A	145	900
Dire Dawa	N/A	N/A	12	12/05/99	500	N/A	N/A	N/A
Gambella	N/A	5	N/A	N/A	N/A	N/A	N/A	N/A
Tigray	1	1	1	N/A	N/A	2	N/A	N/A
TOTAL	**13**	**72**	**683**		**162,498**	**102,102**	**23,203**	**7,933**

Source: Report of FAO Ethiopia based on information from the Crop Production and Protection Technology and Regulatory Department of the Ministry of Agriculture.

In Ethiopia, armyworm outbreaks were first reported in SNNPR (Southern Region) on 15 April with subsequent infestations reported in Oromia and the Somali National Regional State. The Somali Region in their Plan of Action of 19 May, reported 69,000 hectares of cropland in Jigjiga were infested with somewhat milder infestations in Kebre Biyah, Harshin, Moyale, Filtu, Fik, Awbere, Babile, Erer and Degeh Bur. This same report also requests in-kind or cash assistance from the international community for fuel, dry-cell batteries and miscellaneous expenses in order to undertake control operations without delay.[13] Although the initial infestations in the Somali Region were serious, on the night of 19 May there was an exceptionally heavy rain in the Jigjiga area that, although causing some damage in the town, destroyed most of the armyworms.

[11] *Arming Against the Armyworm –" The Recurring Problem"*, Dr. Robert Shank, UN-EUE, February 1997

[12] *Armyworm Poses Potential Threat to* Gu *Crop*, FSAU, 19 May 1999

[13] Submission of Plan of Action Regarding Armyworm Infestation, Labor and Social Affairs Bureau, Somali National Regional State, 19 May 1999.

A report prepared by FAO in Ethiopia on information supplied from the Crop Production and Protection Technology and Regulatory Department of the Ministry of Agriculture indicates that as of 20 May 162,498 hectares of cropland and 102,102 hectares of pasture were reported by various regions to be infested with armyworms. Control operations had already started in most of the affected regions and so far no serious crop damage had been reported. The Ministry of Agriculture also report that they have sufficient stocks of pesticide to deal with the current levels of infestation.

Although the situation seems to be under control at the moment, if weather conditions remain favorable further infestations could take place in northern Ethiopia and Eritrea. Also, as control measures in Somalia may be difficult, re-infestation of Ethiopia from Somalia is also possible. Armyworm infestations can devastate large tracks of cropland and prompt interventions are critical. If the 1999 armyworm infestation becomes as severe as the 1994 outbreak then additional donor assistance may be required.

ACKNOWLEDGEMENTS

All figures in this report have been reproduced from the 1993 FAO publication "A Guide to Migrant Pest Management in Africa", edited by Dr. Wolfgang F. Meinzingen (available from the UNDP-EUE library)

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