INTEGRATED MANAGEMENT AND BIONOMICS OF FALL ARMYWORM (FAW) ON MAIZE – A REVIEW

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Abstarct

The Fall armyworm FAW, *Spodoptera frugiperda* (J.E.Smith) is a notorious insect of high dispersal ability, voracious feeding, wide host range, and high fecundity that make it one of the most severe economic pest. This devastating insect-pest, officially reported in Nigeria in West Africa in 2016 and rapidly spread across 44 countries in sub-Saharan Africa, In July 2018 it was confirmed in India (Karnataka) and Yemen. It belongs to the Lepidoptera family under order Noctuidae. The pest is reported to infest over 80 plant species, with a high preference for maize. Fall armyworm damages leaves, tassels as tattered holes. Heavy feeding may result in the appearance of hail-damaged corn. In many parts of Africa and Asia, the ideal climatic conditions for fall army worm existing and the availability of sufficient host plants indicate that the pest may produce many generations in a single season and is likely to result in the pest becoming endemic to those regions. Plentiful research is going on for a general common management practice for fall armyworm to protect fields. The key to their management is to detect emerging fall armyworm infestations before they cause economic damage. Different Integrated pest management measures and bionomics are discussed in this review paper.

Index terms **–**Bionomics, *Spodoptera frugiperda,* Entomopathogens, Management, Abiotic factors.

INTRODUCTION

Maize is one of the fundamental and basic grain crops because of its high incentive as a nutritious food and interest for corn and fuel from creatures and furthermore for development desire. *(Abebe and Feyisa, 2017)*. Maize is likewise the better noteworthy stable output in Ethiopian rustic families in term of calorie admission. Around eighty-eight percent of Ethiopian maize is utilized as food in both green cobs and grain. *(Nigussie, Tanner, and Twumasi-Afriyie, 2002)*. Current maize efficiency is underneath its latent capacity, albeit still higher than that of other significant oat crops. The low yield is ascribed to a blend of a few creation requirements chiefly absence of improved creation advances, for example, bug the executives rehearses, dampness stress, low fruitfulness and poor cultural practices (*Tufa and Ketema, 2016).* Huge quantities of larval armyworms tormenting different crop of monetary significance are intermittently recorded in numerous nations of tropical Africa. *Rose DJW et al (2000)* when first perceptions of armyworms were made in late January 2016 on maize plants in the rainforest zone of South-Western Nigeria and in maize fields at the International Institute of Tropical Agriculture (IITA) at Ibadan and Ikenne, assaults were at first credited to indigenous types of the family *Spodoptera Guenee*. *Goergen. G et al (2016).*

The fall army worm is a most damaging yield nuisance, known to assault in excess of 353 plant species over the globe *(Montezano et al., 2018; CABI, 2020).* In Asia, the fall army worm distinguished unexpectedly during 2018 plaguing maize crop in K.N. province of India *(Ganiger et al., 2018)* and it spread rapidly to numerous Indian states *(Singh, 2019),* including upper east (NE) India *(Firake et al., 2019).* Fall army worm spread quickly into China, Bangladesh, Indonesia, Japan, Korea, Republic of Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam and Yemen *(CABI, 2020).* First perceptions of fall armyworm, *S. frugiperda* were made toward the beginning of May-June 20l8 in maize fields. At College of Agriculture, Shivamogga, K.N, India. Further, its essence was recorded in various regions of K.N. During the principal fortnight of June 2018, after rehashed calls by maize producers and the Department of Agriculture, Davanagere District, an overview was led to survey the occurrence and affirm its essence in various areas. *Kalleshwaraswamy CM et al (2018)*. Fall Armyworm, *Spodoptera frugiperda* (J E Smith) (Lepidoptera, Noctuidae) into India It is local to the tropical and subtropical area of America, where it is a genuine nuisance of corn yet in addition known to assault in excess of 100 hosts. Also, it is accounted for to make significant harm financially significant growing crops, for example, rice, sorghum, and sugarcane just as 23 agricultural yields like cabbage, beet, tomato, potato and onion other than cotton, field grasses, nut, soybean, hay and millets *(Pogue, 2002; Chapman et al., 2000; CABI, 2016). Till 2015.* Maize is the second most significant grain crop in upper east India, close to rice, and is generally developed by little land holding organic farmer in rainfed uneven upland conditions. Fall army worm foundation will wreck destruction for such ranchers. *(Ansari et al., 2015).* The productivity of FAW related with its capacity to move significant distances are two of the species characteristics that could clarify the speed at which it attacked the landmass. (*Rose et al., 1975, Sparks, 1979)*The predominance of maize and different yields on which this exceptionally polyphagous bother takes care of related with agro environmental conditions reasonable for FAW in a great part of the area makes it a genuine danger to food security *(Day et al., 2017).* The FAW, *Spodopterafrugiperda* is a cosmopolitan nuisance of the corn crop. It attacks from all development phases of maize yet most regularly in the whorl of youthful plants as long as 45 days old. FAW hatchlings normally expend a lot of foliage and some of the time damage the cultivating the plant *(Wiseman et ai., 1966).*

ECOLOGY (LIFE-CYCLE): Fall Army Worm has several generations in line with year. Life cycle together with egg, six to seven larval instars, pupa, and person. Six or extra generations per year can also occur *(Luginbill 1928)*. Finishing touch of the existence cycle usually takes approximately 4 weeks. But can take so long as 12 weeks throughout periods of low temperatures inside the spring and fall *(Vickery 1929).*Eggs are generally laid on the underside floor of leaves. Female will oviposit eggs on all plant components. The most favoured region for ovipositor is on leaves rising without delay from the primary stem in the middle to decrease portion of the plant cover *(Luginbill 1928, Sparks 1979, Ali 1989)*.Upon eclosion, neonates devour the egg mass from which they hatched. Larvae then disperse in all instructions, starting to feed on vegetative tissue. Later instars favour to feed on reproductive structures inclusive of squares (flower buds) and bolls. Larval feeding and adult pastime most frequently occur at night, but can occur in past due night time and early morning. Number of instars can range from six to seven relying on environmental conditions and availability of food. The very last instar will consume a more amount of meals than all previous instars combined *(Luginbill 1928)*The period of time for larval improvement (hatching to pupation) varies based on temperature and environmental situations, however can variety from 11 to 50 days *(Luginbill 1928, Hogg et al. 1982).*Larvae fall from the plant and burrow into soil to a intensity of one-3 inches in the soil, stay in a prepupal stage for two - 4 days, and pupate there for seven -ten days *(Luginbill 1928, Pitre and Hogg 1983)*. Intensity of pupation relies upon factors such as soil texture, soil moisture, and soil temperature *(Sparks 1979).* As moths emerge from the soil, they can mate locally or migrate as much as 300 miles earlier than mating and ovipositing *(Ashley et al. 1989).*

ABIOTIC FACTOR ON LIFECYCLE OF FALL ARMY WORM

Field observation literature and experimental studies on fall armyworm to investigation the relations between the environment and their effect on life cycle.

In heavy rain fall $1^{st}$and 2^{nd} instar larva feeding rate increases between 25-30C^0. 3^{rd} 4^{th} and 5^{th} instar larva increases feeding rate at 25–30C^0 and infection rate increases in minimum irrigation crop. 6^{th} and 7^{th} instar larva feeding rate as well as development rate decreases between the temperatures of 21–30C^0. Viability minimum at 32C^0 duration decreases between at 18-32C^0. Pupa duration decreases between18-32C^0survival rate greatest at 25$C^0$and development rate 30-35C^0 longevity decreases between21-30C^0. Ovipositor fecundity highest at the temperature 12-25C^0, 30C^0 and egg laying capacity highest at the temperature of 24.6-25C^0 minimum 9.7C^0*Elderd BD and Reilly JR (2014), Barfield CS and Ashley TR (1987), Busato GR et al (2005)*

Eggs:-

Egg of the Fall Army Worm is "oblate-spheroidal" in form. Freshly oviposited eggs are to start with greenish grey in colour, afterward appear brown, and emerge as almost black. *(Luginbill 1928)*. Oviposition can be initiated in the course of the early night hours. Eggs are laid in hundreds and hatch inside 4 days under beneficial conditions *(Dew 1913, Luginbill 1928, Sparks 1979).*

Larva: -

First instars, hatchlings are shading greyish to yellow with zit containers, and little dark spots essential setae jut. Hatchlings obscure as they take care of and seem greenish in shading *(Luginbill 1928).* Continuing two larval instars (Larval 2–Larval 3) are comparative in shading to prior instars soon after shedding from the previous instar, however ordinarily obscure only preceding shedding to the procedure instar. The three last instars larval 4 – larval 6 are regularly dim in shading, with changing shading designs relying upon their eating routine and different variables. The hatchling shows a conspicuous transformed "Y" on the head container. The head case is customarily dim dark in shading. *(Luginbill 1928)* Later instars (Larva 4–Larva 6) need essential setae and are commonly smooth *(Oliver and Chapin 1981)*.Markings on the hatchlings can remember a not continuous white line for the mid-dorsal territory, just as yellow and red "flecking" on the venter (mid-region). Hatchlings likewise have an unmistakable example of four "specks" on the eighth stomach fragment. The pupal case has an orange-earthy coloured appearance. *(Luginbill 1928).*

Adult: -

The moths have a wing size about 32 to 40 mm. In the male moth, the forewing by and large is concealed dim and earthy coloured, with three-sided white spots at the tip and close to the focal point of the wing. The forewings of females are less particularly checked running from a uniform greyish earthy coloured to a fine mottling of dark and earthy coloured. The rear wing is luminous silver-white with a limited dim fringe in both genders. Grown-ups are night time, and are generally dynamic during warm, damp night times. Term of grown-up life is assessed to average around 10 days. (*Luginbill 1928).*

ECONOMIC DAMAGE: -

Fall Army Worm cause critical harm to various financially significant developed grasses including maize, rice, sorghum and sugarcane, yet additionally to vegetables and cotton. Past harm assessments have indicated that pervasions during mid-to-late maize development stages can bring about yield misfortunes of 15–73% *(Hruska and Gould, 1997)*. Contingent upon the development phase of maize, fall armyworm hatchlings are found on youthful leaves, leaf whorls, decorations or cobs *(Goergen et al., 2016)*. Fall army worm on sweet corn causes more injury at the late whorl stage contrasted with ahead of schedule and mid-whorl stages. However, better plant recuperation occurs during early formative stages *(Hanway, 1969).* Fall army worm caterpillars give off an impression of being substantially more harming than African armyworms (Spodopteraexempta) to maize in late whorl stages comparative with right off the bat in the mid-stage *(IITA, 2016).* Fall army worm invasion on sweet corn causes more injury at the late whorl stage contrasted with right on time and mid-whorl stages. Marenco, *Foster and Sanchez (1992).* Yet, better plant recuperation occurs during early formative stages *(Hanway, 1969).* African armyworms first develop thick populaces on wild grasses before more established hatchlings move onto developed graminaceous crops, while grown-up females of FAW legitimately oviposit on maize *(Rose, Dewhurst, and Page, 2000).* The grown-up female lays the eggs in masses, haphazardly dispersed inside the yield. Throughout the late spring, egg bring forth happens in 3 days. The recently brought forth hatchlings quickly start feedings on the tissues, First instar hatchlings as a rule eat the green tissue from one side of the leaf, leaving the membranous epidermis on the opposite side unblemished. More seasoned instars start to make openings in the leaf and the fourth to 6th instars may totally annihilate little plants and strip bigger ones *(Cruz, 1995).*

Yield decreases in maize because of taking care of the fall armyworm have been accounted for as high as 34% *(Carvalho, 1970; Cruz and Turpin, 1982; 1983, Williams and Davis, 1990; Willink et ai., 1991; Cruz et ai., 1996)*. FAW hatchlings at the beginning phases of plant advancement was principally from benefiting from the leaves and on the delicate tissue that grows profound Larvae keep benefiting from the leaves during the mid-whorl phase of plant improvement, yet additionally feed on the creating decoration. Tuft harm happens until decorations rise, when the hatchlings are compelled to look for more secured zones, ordinarily the ears. *Ghidiu and Drake;1989)*

The female lays over a thousand eggs in single or bunches structure. After bring forth, the early instar secretes luxurious string and is scattered through wind0. The first and second instar hatchlings scratching found on the upper surface of the leaves. Third instar onwards, the hatchlings get comfortable the whorl and their taking care of renders a progression of openings and fecal issue in the spread out on leaves. Their taking care of rate increments with development; in this manner, the size of openings and measure of fecal issue likewise increment. The 6th instar hatchlings defoliate vigorously and leave a lot of fecal issue in the plant whorl. More established hatchlings at times bore the creating internodes of early whorl phase of maize and cause plant passing. The hatchlings may assault tuft and creating ears too. *(Suby S.B et al; 2020)*. First to third instar hatchlings of Fall Armyworm hush up little and eat 2% of the complete foliage expended in their life cycle, while it is 4.7%, 16.3% and 77.2% for the fourth, fifth and 6th instars which vigorously defoliate the harvest. *(Suby S.B et al; (2020).*

YIELD ASSESSMENT IN MAIZE DUE TO FALL ARMYWORM *SPODOPTERA FRUGIPERDA*

Damage to Plant: -

Consistent fruitfulness of the vermin at great condition is foreseen to result a serious harm to crops *(Goergen et al., 2016)*. Both vegetative and conceptive structures of the plants are devoured by the hatchlings. Epidermal leaf tissues are generally favoured by the youthful hatchlings and make openings in leaves, which is the particular harm side effect of FAW. Dead heart is a side effect brought about by taking care of youthful plants through the whorl. The developed hatchlings present in the whorls of more established plants can benefit from maize cob or portions, diminishing yield and quality *(Abrahams et al., 2017; Capinera 2017).* Extensive harm to maize is brought about by FAW hatchlings by benefiting from youthful leaf whorls, ears and decoration which incidentally prompts absolute yield misfortune *(De Almeida Sarmento et al., 2002)*. In maize, FAW assaults all harvest stages from seedling rise through to ear improvement. They defoliate and can slaughter youthful plants, whorl harm can bring about yield misfortunes, and ear taking care of can bring about grain quality and yield decreases *(Capinera, 2017).* Identifying FAW pervasions before it causes monetary harm is the way in to its administration. In the event that pervasions are identified past the point of no return, the effects of harm perhaps irreversible *(Rwomushana et al.,2018, Capinera,2017)*. Ongoing appraisals by CABI in 12 maize-delivering nations demonstrated that without control, FAW can cause maize yield misfortunes going from 4.1 to 17.7 million tons for every year, which is proportional to an expected misfortune between US$ 1088 and US$ 4661 million yearly *(Rwomushana et al 2018)*. As of late, *Baudron et al.,2019* announced yield loss of 11.57% due to FAW harm in smallholder maize fields in Zimbabwe, which is moderately lower than the apparent misfortunes detailed by smallholder ranchers in various nations, for example, in Ghana and Zambia *(Abrahams et al.,2017, Rwomushana et al.,2018).*

Damage to Corn: - The nuisance causes hefty harm on corn and yield misfortunes of over 70% have been recorded *(Hruska and Gould, 1997).* Yield decrease in maize because of harm of FAW hatchling of about 39% was accounted for in America *(Cruz et al., 2012).* An estimate on yield misfortunes due to fall army worm was made up to 40% in Honduras *(Wyckhuys and O'Neil 2006)* and 72% in Argentina *(Murúa et al. 2006)*. Maize yield loss of 20–half in late gauges at Africa recommends extreme effect on vocations of the ranchers relied upon Maize cultivating *(Early et al., 2018).* Progressive examinations have demonstrated that the irritation has been recognized in more than 30 sub Saharan African nations where it has made broad harm crops particularly maize fields *(Prasanna et al., 2018).*

Fig.1. Damage caused by *Spodoptera frugiperda*

CONTROL MEASURE APPLY (FALL ARMYWORM)

Distinguishing FAW pervasions before cause monetary harm is the way in to their administration. On maize, if 5% of seedlings are cut or 20% of whorls of little plants (during the initial 30 days) are swarmed with FAW, it is prescribed to apply a compelling control measure to forestall further harm *(Fernández, 2002)*

Cultural management

Cultural control is a significant segment of an irritation the executive's technique for fall army worm Maize just editing frameworks offers a positive domain for fall army worm to spread quickly. The social control incorporates maintaining a strategic distance from late planting since the maize ears would be vigorously assaulted by a higher fall army worm pervasion than those of the early plantings. Additionally, intercropping and turning maize with non-have crops like sunflower and bean might be valuable to limit the attack of fall army worm *(FAO, 2018)*. The greater part of the rancher keeps away from the concoction strategy. They don't have any significant bearing substance to maize crop bother. They do culture practices to control the fall armed force worm like an intercropping, handpicking and murdering of caterpillars, use of wood remains and soils to leaf whorls *(Abate et al., 2000).*

Perfecto and Sediles (1992) showed that maize intercropped with beans led to a 28% decrease in FAW infestation. Degri et al. (2014) studied the effect of intercropping pearl millet with groundnut on stem borer infestation of millet in Nigeria and found up to 48% reduction in the per cent of plants infested with stem borer and a 58% reduction in the number of borers per plant. This reduction was attributed to the increased levels of natural enemies found in the intercropped fields. Midega et al.(2006) found that in the push-pull system there is an increased abundance, diversity and activity of predatory arthropods, contributing to reducing pest populations

Cañas and O'Neil (1998) tested a traditional practice in Honduras of spraying sugar water in maize fields and found that the sugar-treated maize had higher numbers of natural enemies, 35% less FAW leaf damage and 18% lower plant infestation rates than maize treated with water alones

Mechanical Control: - Monitoring their fields periodically for the duration of the vegetative level and crushing egg loads and younger larvae is a powerful management desire for small and marginal farmers. In the USA, a few smallholder farmers mentioned pouring ash, grit, sawdust, or dust into whorls to adjust FAW larvae *(FAO, 2018).* Young larvae can come to be desiccated via ash, sand, and sawdust. Maize farmers also record the use of lime, salt, oil, and soaps as manage measures in crucial the united states and Africa. Ash and lime are alkaline. The achievement of the usage of neighbourhood botanicals which includes neem, warm pepper, and local vegetation changed into also recorded by using a few farmers. Minimum respectable scientific studies on these local controls had been carried out, but many farmers in Africa have also stated success with them. *(FAO, 2018).*

Biological Control: - Organic control may be considered as a powerful device and one of the maximum critical alternative Control measures providing environmentally secure and sustainable plant protection. The achievement of Biological control relies upon on know-how the variation and establishment of carried out organic Control retailers in agricultural ecosystems. *(Pilkington, Messelink, van Lenteren, and Le Mottee, 2010).*A number of parasitoids, predators and pathogens with no trouble assault larval and adult stages of FAW. The use of living organisms to minimise a particular pest organism's population density or effects, making it less abundant or less dangerous. *Eilenberg et al. (2001)*

Different predator feeding on fall army worm.

The predators of FAW are generalists that attack larvae of other lepidopterans. In the Americas, the most important predators of FAW that have been reported include various ground beetles (Coleoptera: Carabidae); the striped earwig, *Labidurariparia* (Pallas) (Dermaptera: Forficulidae, Labiduridae), Doruluteips, Dorulineare, and other earwigs (Jones, Gilstrap, and Andrews, 1988; Romero Sueldo, Dode, and Virla, 2014; Silva et al., 2018); the spined soldier bug, *Podisusmaculiventris* (Hemiptera: Pentatomidae); and the insidious flower bug, **Oriusinsidiosus** (Hemiptera: Anthocoridae) (Capinera, 2001). Among the vertebrate predators, birds, skunks, and rodents also feed on larvae and pupae of FAW (Capinera, 2000).The predators, *Andrallusspinidens*, *Eocantheconafurcellata*, *Forficula* spp. and ground beetles have all been reported feeding on Fall Army Worm life stages in southern India. Shylesha and Sravika, (2018), Sharanabasappa *et al* (2019)

Table1; Different parasitoids are found on fall army worm life stages

Sr no.	Different types parasitoids	Name of parasitoids	Author
1	Egg	*Trichogrammasp.*	(Amadou*et al*, (2018)
		Trichogrammatoideasp	(Amadou*et al*, (2018)
		Telenomussp.	(Amadou*et al*, (2018)
		Telonomusremus	(Kenis*et al*, (2019)
2	Egg larval	*Chelonussp.*	(Amadou*et al*, (2018)
		curvimaculatusCameron	(Sisay*et al*, (2018)
3	Larval	*Cotesia. icipe*	(Sisay*et al*, (2018)
		Pterolophia. Zonata	(Sisay*et al*, (2018)
		Corpus. luteum	(Sisay*et al*, (2018)

		Cotesia sp.	(Amadou*et al*, (2018)
		Charopssp.	(Amadou*et al*, (2018)
		Ichneumonid fly	(Amadou*et al*, (2018)
		Tachinid fly	(Amadou*et al*, (2018)
4	Larval-pupal	*Meteoridea* cf	Goulet H and Huber JT (1993), Riedel M (2016)
		Metopiusdiscolor	Goulet H and Huber JT (1993), Riedel M (2016)

DIFFERENT ENTOMOPATHOGENS CONTROL THE FALL ARMY WORM

The FAW is reported to be susceptible to at least 16 species of entomopathogens including viruses, fungi, protozoa, bacteria, and nematodes (Agudelo-Silva, 1986; Fuxa, 1982; Gardner and Fuxa, 1980; Molina Ochoa et al., 1996; Richter &Fuxa, 1990). Among the pathogens, *Bacillus thuringiensis, Metarhizium anisopliae and Beauveria bassiana* can cause significant mortality in FAW populations and help to reduce leaf defoliation in crops (Molina- Ochoa et al., 2003). These authors reported 3.5 % FAW larval mortality in Mexico due to naturally occurring entomopathogens and parasitic nematodes. Hence,1.5% microbial insecticides are only used in of the Mexican agricultural land (Blanco et al., 2014)

Seed treatment: -

The need for foliar sprays towards FAW changed into decreased by using chlorantraniliprole and cyantraniliprole as seed remedies. Thiodicarb and clothianidin decreased the variety of flora reduce or injured by FAW in laboratory checks, however chlorpyrifos, fipronil, thiamethoxam, and kerosene were no longer successful. *(Camillo, Di Oliveira, de Bueno, and Bueno, 2005) (Portillo, Meckenstock, and Gómez, 1994)*

Botanical control: -

The usage of botanical pesticides is usually recommended rather to hazardous artificialInsecticides, which include pyrethroids and organophosphorus which may additionally result in disturbances in the environment increasing consumer value, pest resurgence and pest resistance to insecticides*(Arya and Tiwari, 2013)* due to affordability and availability of botanical insecticides, farmers in developing countries have used these safer and more environmentally friendly tools for hundreds of years to govern insect pests of both discipline plants and stored merchandise *(Schmutterer, 1985)*. Amongst many other botanicals, extracts of vegetation which include *Azadirachtaindica, Milletiaferruginea, Croton macrostachyus,Phytolaceadocendra, Jatropha curcas, Nicotina tabacum* and *Chrysanthemum cinerariifollium* have been used effectively to govern insect pests (*Jirnmci, 2013; Schmutterer, 1985). Silva et al. (2015)* said high larval mortality of FAW the usage of seed cake extract of *Azadirachta Indica*. In latest studies, ethanolic extracts of *Argemoneochroleuca* (Papaveraceae) prompted FAW larval mortality due to a reduction in feeding and slowed larval growth *(Martínez et al., 2017)* Extracts of many other flowers display insecticidal pastime against FAW *(Batista-Pereira et al., 2006)*, but particularly few had been efficaciously commercialized. *Azadirachtin* (from neem) and pyrethrins (from pyrethrum) are the maximum broadly used merchandise at some stage in Latin the United States. A few merchandise primarily based on rotenone, garlic, nicotine, rianodine, quassia and other extracts had been registered international *(Isman, 1997).*

Table2. Different biochemical used against fall army worm Research conduct in country Ethiopia

Sr.no	Botanical name	Rate /g	Plant Extraction	Author
1.	*Azadirachtaindica* (Neem)	5g	Seed extract, leaf extract	Begna F, and Damtew T(2015)
2.	*Militia ferruginea* (Birbira)	50g	Seed extract	Ararso Z (2010)
3.	*Jatropha curcas* (Jatropha)	11.5g	Seed extract	Wondimu M (2013)
4.	*Meliaabyssinica* (Melia)	8g	Leaf extract	Selvaraj M; and Mosses M (2011)
5.	*Chenopodium ambrosoids* (Mexican tea)	35g	Leaf extract	Shiberu T and Ashagre H (2013)
6.	*Lantana camara* (lantana)	400g	Seed extract	Begna F, and Damtew T(2015), Raghavendra, KV *et al* (2016)
7.	*Eucalyptus globulus* (Eucalyptus.)	25g	Seed extract	Shiberu T *et al* (2013)
8.	*Nicotinatabacum* (Tobacco)	25g	Tobacco leaf	Shiberu T *et al* (2013)
9.	*Phytolaccadodecandra* (Endod)	25g	Seed extract	Shiberu T *et al* (2013)
10.	*Croton macrostachyus* (Bisana),		Seed extract	Shiberu T et al (2013)

Chemical control: -Manipulate of the fall navy malicious program is usually done by using making use of synthetic pesticides *(Blanco et al, 2014, 2010; Hruska and Gould, 1997)*. At this point, there aren't any registered chemicals for FAW in Ethiopia, but special popular pesticides are being used (consisting of organophosphate carbamate and pyrethroids, For a hit pest manipulate, the exact timing for the application of chemicals may be very vital; each the life cycle and the time of day rely, i.e. Spraying is useless whilst larvae are deeply embedded inside the whorls and ears of maize; and spraying during the day is useless due to the fact larvae best come to feed on plants at night time, sunrise or dusk (Day *et al2017)*.

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