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Short communication

Effect of Spent Engine Oil and other Natural Materials on the Emergence of Harvester Ants (*Messor galla* Forel) in North Eastern Nigeria

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Harvester ants (*Messor galla* Forel) are field and store insect pests that may cause extensive damages to crop production. Two field experiments were conducted to evaluate the effects of spent engine oil and other nature-based materials on the emergence of harvester ants in Maiduguri, Borno State of Nigeria. The treatments evaluated were spot application of spent engine oil and some natural materials, or the application of individual and equal mixture of pure neem seed kernel oil and spent engine oil. Spot application of permethrin served as control. There was no significant difference between permethrin and spent engine oil regarding their effects on the population index of the harvester ants ($P > 0.05$). Neem seed oil was significantly more effective than the untreated control ($P < 0.05$). However, after 4 weeks application, aqueous neem seed extract, salt/potash solution, and extract of *Eugenia aromatic* fruit showed no significant difference in the population index of ants that emerged from treated nests in comparison with the untreated control ($P > 0.05$). No significant difference was observed between permethrin, spent engine oil, neem seed kernel oil, and equal mixture by volume of pure neem seed kernel oil and spent engine oil in controlling the emergence of the ants ($P < 0.05$). These were however, significantly different from the untreated control ($P > 0.05$). Equal mixture of spent engine oil and neem seed kernel oil was most effective, followed by spent engine oil, permethrin, and neem seed kernel oil. This study have shown probably for the first time, the potential of spent engine oil and neem seed kernel oil individually or in combination as a cheaper, technically effective, and conservation minded alternative to synthetic pesticide in harvester ant management.

Keywords: Harvester ants (*Messor galla* F.), permethrin, spent engine oil, neem seed oil.

Harvester ants, *Messor galla* Forel have been established to be a serious granivorous field and store insect pest of small grain cereals in the tropics and sub-tropics (1, 2). They form complex colonies and are soil dwelling and their foraging activity may interfere with sowing and harvesting of grains. Cereal grains like millet, wheat, sorghum and rice are major staple foods and raw materials in bakeries and brewing industries which have been reported to be ravaged by the activities of harvester ants (3). As a field and store pest, the harvester ant may cause extensive damage and losses by foraging on sown seeds, sometimes feeding on germinated crops, and also climbing some plants and harvesting mature seeds (4, 5).

They also reduce plant stands by denudation of cultivated lands as they destroy the plants around the entrance to their nest leading to bare patches in the

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fields measuring several square meters. Hence, large areas for crop production are lost year after year by the activities of harvester ants (3).

The need to search for a cheaper and environmentally amenable pest management strategy that can be incorporated into the integrated pest management (IPM) of harvester ants becomes apparent in view of its importance as yield reducer and the significance of cereal grains in most especially semi-arid Northern Nigeria.

The fact that a great number of small cereal grains like millet are mostly cultivated at subsistence level in the savanna regions of Nigeria (6), points to the need to device or recruit a cheaper means of control. In Borno state of Nigeria as in some other places, Pif-Paf (permethrin) is the most common measure spent in controlling this insect pest.

Aside the cost, there is a wide cry for reduction in the quantity of chemical pesticides in spent due to the risks associated with them. It has also been reported that farmers in France added spent engine oil to synthetic insecticides for greater effect (7). This implies that spent engine oil could be a synergist by making the insecticide more efficient.

Spent engine have also been applied into the poles of granaries to repel termites and resource limited farmers have been reported to use spent engine oil to control external parasites (mites, fleas, lice and tick) on free-range chickens at Amatola basin, in eastern cape, South Africa (1,4,7) .

However, spent engine oil have been shown to contain polycyclic aromatic hydrocarbons making them to have adverse effects on man, plants, microbes and aquatic lives (8, 9). However, they are biodegradable in the soil within certain limits as soils have inherent abilities to remediate contaminants unlike some recalcitrant pesticides (10). They are easily accessible as mechanics indiscriminately dispose them off in most urban ce nterss in Nigeria.

Several reports have shown that Neem seed kernel oil is efficacious in pest management and non persistent, hence environmentally friendly. This research aimed therefore at assessing the efficacy of spent engine oil and natural materials in managing harvester ants.

Materials and Methods

Choice of test sites

Areas infested with harvester ants nest where located within Maiduguri, Borno State of Nigeria. The surrounding of the nests; about one meter radius from the nest hole were cleared of grasses and debris where necessary. Presence of the ants in the nests sampled was ascertained by placing untreated millet grains some 50 cm from the harvester ants' nest entrance. The population of the ants was then recorded using the rating scale (population index) illustrated below.

Experimental design

Two experiments were conducted using a randomized complete block design (RCBD) with seven treatments in experiment 1 and five treatments in experiment 2, both in four replicates. Therefore, a total of 48 nests were spent for the experiments.

Evaluated treatments

The treatments evaluated for experiment 1 were Pif-paf powder (permethrin), aqueous neem seed extract, neem seed oil, spent engine oil, salt and potash solution, and extract of *Eugenia aromatica* fruit.

The treatments evaluated for experiment 2 were permethrin, neem seed kernel oil (NSKO), spent engine oil (SEO), equal mixture by volume of NSKO + SEO.

For both experiments, nests with no material applied served as control.

Procedure for preparation and application of treatments

1. Pif-paf (permethrin): 125 g of pif-paf powder was turned into 5 l of water (i.e., 25 g/l)

2. Aqueous neem seed extract: 250 g of ground neem kernel was turned into 5 l of water (i.e., 50 g/l), shaken very well and left to stand for 12 h. Spent engine oil: SEO was obtained from mechanic workshops.

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3. Salt and potash solution: 125 g each of salt and ground potash was turned in 5 l of water, thoroughly shaken and left to stand for 12 h.
4. Extract of *Eugenia aromatic* fruit: 250 g of the fruit was turned in 5 l of water, shaken very well and left to stand for 12 h.

Two l of each tested component were poured into separate harvester ants nests. After 3 h of treatment application to allow for stabilization of the nests, untreated millet seeds were again placed 30 cm away from the nest entrance. This was done to boost ant's foraging activity.

Data collection

Data on harvester ants' population were taken using the population index described below, a day after application and subsequently at weekly intervals for 4 weeks at about 8 pm. The population index used was < 10 ants, 11 – 30 ants, 31 – 50 ants, 51 – 70 ants, 71 – 90 ants, 91 – 110 ants, > 110 ants.

Data analysis

The data collected were subjected to analysis of variance (ANOVA) using the analytical software, 1989, statistix version 3.1 (SX) and significant difference between treatments was done using the Duncan Multiple Range Test at 5% level of probability.

Results

Experiment 1

The effects of nature-based materials on the population index of harvester ants are summarized in Table 1. There was no significant difference ($P > 0.05$) between the treatments in terms of the population index of the harvester ants before the treatments were applied. However, on the 1st day post treatment application, all the other treatments, aside salt/potash solution had significantly lower population of harvester ants emerging when compared with that of control nests ($P < 0.05$), with permethrin and SEO having the higher suppressive effect. On the 7th day after application ant density on aqueous neem seed extract and salt/potash solution treated nests were statistically at par with those on control. The Table further shows that, on the 14th day post treatment; ants' density in nests treated with aqueous neem seed extract, salt and potash solution and the extract of *Eugenia aromatic* fruit were not significantly different from those on the control ($P > 0.05$). Though, neem seed oil was significantly more effective than the treatments aforementioned ($P < 0.05$), it was significantly less effective than permethrin and SEO. A similar trend was observed on the 21st and 28th day post application.

Experiment 2

The effects of NSKO and SEO on the population index of harvester ants are summarized

Table 1. Effects of nature-based materials on the population index of harvester ants (*Messor galla* Forel)

Treatment	BA	1 DAA	1 WAA	2 WAA	3 WAA	4 WAA
Untreated control	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}
Permethrin	6.00^{a}	1.00^{c}	1.00^{d}	1.00^{c}	1.00^{c}	1.00^{c}
Aqueous neem seed extract	6.00^{a}	4.75^{b}	5.50^{ab}	6.00^{a}	6.00^{a}	6.00^{a}
Neem seed oil	6.00^{a}	1.75^{c}	2.25^{c}	2.25^{b}	2.25^{b}	2.25^{b}
Spent engine oil	6.00^{a}	1.00^{c}	1.00^{d}	1.00^{c}	1.00^{c}	1.00^{c}
Salt/potash solution	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}	6.00^{a}
Extract of *E. aromatica*	6.00^{a}	5.00^{ab}	5.25^{b}	5.50^{a}	6.00^{a}	6.00^{a}
SE±	0.00	0.29	0.18	0.14	0.09	0.09

BA: before application; DAA: day after application; WAA: weeks after application. Values with identical superscript alphabets do not differ significantly at $P < 0.05$.

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Table 2. Discrete and interactive effects of NSKO and SEO on the population index of harvester ants (*Messor galla* Forel)

Treatment	BA	1 DAA	1 WAA	2 WAA	3 WAA	4 WAA
NSKO	6.00[a]	1.25[b]	1.25[b]	1.25[b]	1.75[b]	1.75[b]
SEO	6.00[a]	1.00[b]	1.00[b]	1.00[b]	1.00[b]	1.00[b]
NSKO + SEO	6.00[a]	1.00[b]	1.00[b]	1.00[b]	1.00[b]	1.00[b]
Permethrin	6.00[a]	1.00[b]	1.00[b]	1.00[b]	1.00[b]	1.00[b]
Untreated control	6.00[a]	6.00[a]	6.00[a]	6.00[a]	6.00[a]	6.00[a]
SE±	0.00	0.22	0.22	0.22	0.39	0.39

NSKO: neem seed kernel oil; SEO: spent engine oil; BA: before application; DAA: day after application; WAA: weeks after application. Values with identical superscript alphabets do not differ significantly at $P < 0.05$.

in Table 2. No significant difference was observed between permethrin, SEO, NSKO, and equal mixture by volume of pure NSKO and SEO in controlling the emergence of the ants ($P > 0.05$). These were however, significantly different from the untreated control ($P < 0.05$).

While the results show no significant difference between the treatments, it was observed that equal mixture of SEO and NSKO was most effective, followed by SEO, permethrin, and NSKO.

Discussion

Harvester ants (*Messor galla* Forel) are voracious granivorous species which have negative impact on crop production on field and in store. They are also threats to non-farmers as they destroy structures by digging their nests on or near the structures and their presence encourages soil erosion (11). There is hardly any viable alternative to synthetic insecticides for their control in the semi-arid regions of Nigeria the cost of which is a limitation for both the resource limited farmers and non-farmers alike. This is aside the environmental and health implication of synthetic pesticides.

Aside SEO being the most efficacious, it was able to synergize the efficacy of NSKO which has been reported widely to be an environmentally friendly pest management tool. This is also in line with the report that farmers in France use SEO to synergize synthetic insecticides (7).

Permethrin is a strong systemic insecticide with contact, stomach and repellent effect. These characteristics may also be attributed to SEO and NSKO as it has been shown that mineral oil based insecticides exhibit the following modes of action against insects: blocking their spiracles and causing asphyxiation, creating thin layer on insects' eggs surface thereby preventing gas exchange, acting as poison by interacting with their fatty acids and interfering with their normal metabolism, causing death of newly hatched individuals and causing hardness in eggs which makes them difficult to hatch (12).

The findings of the present study show that, SEO may be used in circumstances where the rate of infestation is very low. Since it involves spot application, the environmental impact will be less. Where there is moderate level of infestation, the mixture of equal volume of neem and SEO may be used to further lower the quantity of SEO to be used. However, where the infestation level is high, pure neem seed oil can be used since it is not persistent and environmentally friendly.

The performance of permethrin and SEO in these experiments suggests that they have knockdown and repellent effects on the harvester ant species. The use of the oil formulations would be able to save hard currency spent in importing pesticides, and the wasteful and indiscriminate discharge of SEO would be better channeled to a more productive use by way of controlling harvester ants. This study have brought to the fore, probably

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for the first time, the potential of SEO and neem kernel oil individually or compositely as a cheaper, technically effective and conservation minded alternative to synthetic pesticide in harvester ant management.

Conflict of interest

The authors declared no conflict of interest.

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