EFFECT OF NALCO FLY ASH BASED HERBAL PESTICIDES AGAINST PESTS OF CUCURBITS

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Abstract : Fly-ash is amorphous ferro-alumino silicate, an important solid waste around Nalco Captive power plant, Angul. It creates problems leading to environmental degradation due to improper utilization. However, fly-ash is useful ameliorant that may improve the physical, chemical and biological properties of soils and is a source of readily available plant macro and micronutrients when it is used with bio-solids. Supply of nutrients from fly-ash with bio-solids may enhance their agricultural use. The effect of Nalco (NFA) fly-ash-based herbal pesticides on certain insect groups is reported here. The five Nalco fly-ash based herbal pesticides showed efficiency in withdrawing, various groups of pests infecting curcurbits, thus indicating them to be potential bio-pesticides. Among all the treatments, Nalco fly-ash taken seed kernel 10% dust were found to be the most effective against all the test insects, including Epilachna on cucubita and Acalymma on cucumber , followed by NFA + Vitex 10% dust and NFA + Eucalyptus 10% dust and NFA + Ocimum 10% dust.

Keywords : Nalco fly-ash, herbal pesticides and cucurbita.

INTRODUCTION :

Nalco fly ash a resultant of combustion of lignite (F-G) grade coal at high temperature has been regarded as a problematic solid waste. The conventional disposal method for Nalco fly ash leads to degradation of arable land and contamination of ground water. The repeated exposure of fly-ash causes irritation in eyes, skin, nose and results in arsenic poisoning. Coal combustion product generated each year in India is more than 100 MT per annum of which 4 MT is released into the atmosphere. Coal combustion by products are largely treated as waste material. In fact, fly-ash consists of practically all the elements present in soil except organic carbon and nitrogen. It was found that this material could be used as an amendment material in agriculture application. A careful assessment of soil and fly-ash is required before its application as soil ameliorating agent. The present outlets of Nalco fly-ash disposal are using cement, concrete and grout industries but such use only accounted for 40% of fly ash produce by thermal power station. The major problems are faced by the coal thermal power stations all over world is the handling and disposal of fly ash. In Nalco CPP (Captive Power Plant of Angul, Orissa, India, Ash Pond spreads over an area of 700 acres and occupying fertile, cultivable land. Menon (Menon[1], elements in coal and coal combustion residuses, lewis publication, Florida, USA, 1993) Studied the effect of mixed application of fly ash and organic compost on soil and availability and uptake of elements by various plant species very little is known regarding the effect of fly-ash amendment on soil biological properties. B. C. Pradhan and M.Baral have demonstrated the importance of Nalco fly-ash as on insecticide against an array of lepidopterious and vegetables and certain other field crops. Subsequent studies confirmed that Nalco fly-ash could be effectively control the various pests infecting cucurbita, eggplant, tomato and okra both under laboratory and field conditions. All these reports indicated that Nalco fly ash could be a potential dust insecticide and an active carrier in certain insecticides formulation like dust, wettale powder and granules. In the light of these finding study was under taken to synthesize herbal pesticides with Nalco fly ash as a career and to evaluate them for their efficiency against pests of certain vegetables like eggplant, tomato and okra (Ladies finger) ,cucurbita,cucumber Pumpkins.

Physico-chemical properties of fly ash sample collected from captive power plant of Nalco, Angul, and Odisha, India.

Table-1:

Sl.No.	Components	Composition wt % of fly ash obtains from Nalco. Angul
1	Na_2O	0.10
2	AL_2O_3	29.19
3	SiO_2	55.60
4	K_2O	1.09
5.	CaO	3.69
6	TiO_2	2.03
7	Fe_2O_3	4.95
8	BaO	0.00
9.	MgO	2.75
10.	Surface area (m^2/g)	3.75
11	Mean particle size *Um)	13.94

The main raw material, coal fly ash samples were collected from electrostatic precipitator of captive power plant, Nalco, Angul, Orissa, India. The samples contained both amorphous mainly (SiO_2, Al_2O_3) and crystalline components mainly quart and mullete.

MATERIALS AND METHODS:

Following items are collected for the study:-

(i) Fly-ash was collected from the Captive Power Plant (CPP), Nalco, Angul, Odisha,India.

(ii) Plants chosen for developing herbal pesticides with Nalco Fly-ash (NFA) as a carrier were neem – ***Azadirachta indica, Eucalyptus globulus, Vitex negundo, Curcuma domestica, Ocimum sanctum.***

EXPERIMENT :

Dust formulations were generated with 10% concentration . Important pesticidal plant species and their parts used in the present study included seed kernels of neem, leaves of eucalyptus, vitex and ocimum, Rhizome of turmeric .Dust formulations of NFA and plant products of finer fraction were obtained through grinding and filtration and then blended. The products were stored in sealed container and kept at room temperature. These were designated as "Nalco Fly ash based herbal pesticides (NFHP), which included :-

NFA+neem seed kernel 10% dust, NFA+Eucalyptus 10% dust,NFA+Vitex 10% dust, NFA+Ocimum 10% dust, and NFA+turmeric 10% dust.

These biological pesticides were studied[4] for their performance against pests of vegetables with a treated control namely NFA, and untreated control under laboratory[2] conditions.

Dust formulations of the pesticides were applied over the leaves using a laboratory fly ash duster[3] The leaves were sprayed with water prior to dusting for easy adhering of the dust and then air dried. Insects were then allowed to feed. On the treated leaves placed over a moist filter paper and kept in a petridish replicated three times. Observations on symptoms of poisoning and eventual mortality, if any were recorded every 24 hours after treatment other physiological alternations in the insects body systems were also recorded.

Experiments were carried out with the following insects. (Cucurbita) spotted leaf betel (grub and adult), *Epilachna vigintioctopunctata* (Farb), Melano Aphids (Aphis gossypii), (glover), Cucumber moth(Diaphania indica) (nymph and adult) pumpkin beetle Aulacorphoa hilaris), Red spider mite. (*Tetranychus neocaledonicus)* .In order to unravel the mechanism of action of the NFHP on insects, the feeding organs of the test insects were examined for any disfiguration. Mandibles of test insects like Red spidermite. Spotted potato lady bird(Epilachna vigintioctopunctata) and O. nitidula obtained from the first experiment were dissected and their morphological characters were studied.

RESULTS AND DISCUSSION :

Topical application for the NFHP was done, on various insects pests like A.gossypic, *Epilachna vigintioctopunctata* and T. neocaledonicus, Leaves which had an abundant number of these sedentary insects populations were used in the study. After treatment, the insects were

allowed over the feed materials. Observations on the mortality, if any and other subsequent symptomatologies were recorded at 24 hours intervals.

Epilachna, the major defoliator in cucumber plant was effectively controlled in its grub and adult stages by NFA+turmeric dust 10% with 58.68 and 58.83% mortality respectively, followed by NFA+need seed kernel 10% dust with 59.62% mortality in Epilachna grub. In case of adult E.vigintioctopunctata NFA+neem seed kernel 10% dust showed 59.86% mortality table 2.

Results showed that the larvae of Diabrotica were killed effectively with 60.98%. Mortality by NFA+Turmeric 10% dust followed by NFA+neem seed kernel 10% dust (65.10%) NFA+Vitex 10% dust (58.02%) and where as the (Anas tristis) were effectively controlled by NFA+turmeric 10% with 76.71% mortality .NFA+neem seed kernel 10% dust 78.33% and NFA + Ocimus 10% (7166%) followed It was interesting to note that some of the larvae developed physical malformation which made them totally unfit for further life activities. NFA+neem seed kernel 10% dust was more effective in cucurbita (Diaphania nitidula) with 75.02% mortality than NFA + turmeric 10% dust (74.61%) and NFA+vitex 10% dust (71.11%) .NFA+ neem seed kernel 10% dust affected effectively against the(Anas stritis) with (78.33%) mortality followed by NFA+vitex 10% dust (73.81%), cucurbita leafhooper showed its innate susceptibility to NFA+neem seed kernel 10% dust with (59.78%) mortality followed by NFA+turmeric dust 10% (58.42%). NFA+turmeric 10% dust and NFA+ neem seed kernel 10% dust recorded a high rate of mortality (59.78% and 68.33%) in the squash bug followed by NFA+vitex 10% dust, NFA+eucalyptus 10% dust . The Aphids and other sucking pest in cucurbita, was controlled by NFA+turmeric 10% dust with 66.00% mortality. Among the herbal pesticides, NFA+neem seed kernel 10% dust recorded maximum mortality (79.89%), in red spider mite follower by NFA+Turmeric 10% dust and NFA+Vitex 10% dust with 72.61 and 71.09% mortality respectively (table 3& 4).

Examination of the feeding organs, namely mandibles of insects treated with NFHP revealed that they become unfit to grind the food particles subsequently. This was because the sharp tooth ends of the mandibles were bunt due to feeding NFA dust contained in the herbal pesticides tested. Such features of NFA are mainly due to its composition, silica as SiO_2 at 50.62%. This resulted in the cessation of insect feeding and subsequently the insect died on hunger.

Topical application of NFA+turmeric 10% dust showed it to be effective against sucking pest of cucurbita like(Diaphania indica)(nymph and adult) aphids (both green & yellow forms) and (Aulacorphora hilaris). The (Diaphania indica) nymphs were also controlled by NFA+turmeric

10% (74.11%) and NFA+neem seed kernel 10% (74.28%), NFA+Vitex 10% dust (68.23%). NFA+Ocimum 10% dust (67.34%) and NFA+Eucalyptus 10% dust (66.35%) were effective against the (D iaphania indica)nymphs. Similarly,(Diaphania indica) adult were dealt with by NFA+neem seed kernel 10% dust, NFA+Ocimum 10% dust and NFA+Eucalyptus 10% dust with 69.79, 65.34, and 65.34% mortality respectively. The cucumber plant aphids were checked by NFA+Turmeric 10% dust (63.23%) and NFA+neem seed kernel 10% dust (65.00%) NFA neem seed kernel 10% dust in controlling the cucumber plant (Aulacorphora hilaris) (68.05%). NFA+Eucalyptus 10% dust reduced the population of the cucumber plant (Aulacorphora hilaris) significantly in table 3.

Table -2: Laboratory Evaluation of Nalco fly ash based herbal pesticides against insect pest of Cucurbita maxima

Sl. No.	Treatment	Epilachna bettle		Diaphania indica		Aphids	Aulacorphora hilaris
		Grab	Adult	Adult	Nymph		
1.	NFA+neem seed kernel 10% dust	59.62(49.48)	59.86(49.67)	69.79(56.06)	74.28(58.64)	65.00(58.9)	68.05(53.75)
2.	NFA+neem ecucalyptus 10% dust	56.11(48.37)	54.12(47.79)	62.42(52.6O)	66.35(54.96)	61.44(52.05)	62.65(55.16)
3.	NFA+neem vitex 10% dust	52.33(46.76)	52.76(47.78)	59.75(50.04)	68.23(56.35)	60.65(51.57)	58.59(49.76)
4.	NFA+neem ocimum 10% dust	46.03(42.72)	45.33(42.32	65.34(53.93)	67.34(55.14)	56.07(48.49)	58.84(50.09)
5.	NFA+neem turmeric 10% dust	58.68(50.59)	59.83(50.69)	71.23(57.56)	74.11(59.41)	63.23(52.73)	65.03(53.75)
6.	NFA+neem 100% D (treated control) 10% dust	46.00(42.13)	43.33(41.17)	52.00(45.00)	62.00(50.77)	52.00(45.00)	49.60(46.23)
7.	Untreated control	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
8.	CD (P=0.05)	0.013	0.004	0.009	0.485	0.013	0.017
9.	SED	0.005	0.004	0.004	0.237	0.005	0.008

Table -3: Laboratory evaluation of Nalco fly-ash based herbal pesticides against insect pests of Cucumis sativus Overall neem percentage mortality at 72 hours after treatment

Sl. No.	Treatment	Diabrotica undecimpunctata	Acalymma trivittata	Anasa tristis	Diaphania nitidalis
1.	NFA+neem seed kernel 10% dust	60.98(50.72)	63.65 (51.10)	78.33(71.57)	75.02(68.55)
2.	NFA+neem ecucalyptus 10% dust	57.34(49.09)	51.68(68.84)	72.83(77.94)	67.72(54.78)
3.	NFA+neem vitex 10% dust	58.02(60.30)	56.70(48.29)	73.81(68.57)	71.11(58.86)
4.	NFA+neem ocimum 10% dust	53.11(56.64)	61.59(50.96)	71.66(58.58)	70.8567.07)
5.	NFA+neem turmeric 10% dust	65.10(51.00)	64.76(52.41)	76.71(60.81)	74.61(59.08)
6.	NFA+neem 100D (treated control) 10% dust	44.92(41.93)	65.79(52.41)	61.33(63.96)	58.50(52.31)
7.	Untreated control	0.0 (0.0)	50.00(45.00)	0.0(0.0)	0.0(0.0)
8.	CD (P=0.05)	0.008	0.0(0.0)	0.024	0.021
9.	SED	0.003	0.013	0.013	0.009

Table -4 : Laboratory evaluation of Nalco Fly-ash based herbal pesticides against insect pests of Cucurbita muschata (Bullet mut)Over all mean percent mortality at 72 hours after treatment.

Sl.No.	Treatment	Leaf hoppers	Squash bug	Aphids	Red spidermite
1.	NFA+neem seed kernel 10% dust	59.78(53.63)	68.33(54.93)	68.00(56.75)	81.89(69.73
2.	NFA+neem ecucalyptus 10% dust	58.36(48.64)	63.74(63.20)	65.11(53.42)	78.11(69.45)
3.	NFA+neem vitex 10% dust	57.35(49.92)	65.36(63.75)	65.21(53.69)	78.73(73.19)
4.	NFA+neem ocimum 10% dust	49.74(49.85)	60.26(58.74)	63.00(52.78)	75.38(68.36)
5.	NFA+neem turmeric 10% dust	58.42(77.53)	59.78(58.90)	60.50(49.90)	73.09(69684)
6.	NFA+neem 100D(treated control) 10% dust	45.55(42.29)	45610(42.20)	56.50(46.45)	64.50(52.25)
7.	Untreated control	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
8.	CD (P=0.05)	0.009	0.027	0.556	0.139
9.	SED	0.004	0.013	0.226	0.079

Against the cucurbitas pests, including the defoliator and the sucking pests, the most effective treatment was that of NFA+Turmeric 10% dust. For NFA+ turmeric 10% dust, Epilachna (grab adult(Diaphania indica) (nymph and adult), aphids and (Aulacorphora hilaris) showed susceptibility with a mortality rate of 68.05 and 59.62and59.86(grub and adult), 74.28 (nymph) and 69.79 (adult) 68.33 and 68.05 respectively NFA+turmeric 10% dust and NFA+neem seed kernel 10% dust brought about the highest control of the leaf feeders, namely cucurbita (Diaphania nitidula) and the fruit borer, with more than 50% mortality.

Thus, NFA+turmeric 10% dust and NFA+ neem seed kernel 10% dust show promise against the pests of cucurbita inflecting more than 80% mortality, and one fit for field application. These findings confirm the previous one by B. C. Pradhan and M.Baral, who recorded centpercent mortality of various rice pests, including *Cnaphalicrocis medinalis* (*Cuen*, *Melanitis ledaismene (Drury) Parnara Mathias and Oxya nitidula* due to NFA treatment. Similar finngs were made in the control of pests of eggplant, okra, tomato under laboratory condition with Nalco flyash Vijaya Kumar reported that fly ash based pesticides of dust and wettable powder formulation controlled rice pests effectively. From the above, it is clear that NFA has shown its effectiveness in checking

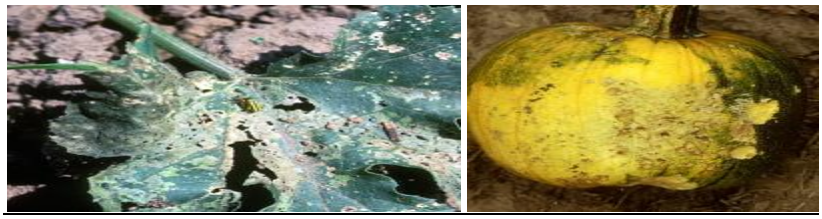
the pests of various crops like rice, eggplant,okra, cucurbits etc. Like- wise, herbal preparations were shown to be effective against various pest populations, namely Acalymma eggs with neem based formulations and dust formulation of neem cake, neem seed kernel against Acalymma larvae and with turmeric rhizome dust against store-grain pests.

CONCLUSION:

From the above, it is clear that both NFA and herbal products are effective in controlling various insect pests independently. In the present study, both the products have indicated their compatibility, and their actions on the insect pests studied were observed to be complementary in nature.

Therefore, NFA, besides being useful as a dust insecticide, also serves as a camera in the dust formulation of herbal products. Besides mortality, other effects like malformation in emerging adults were encountered in cucurbita (Diaphania nitidula) and (Anas stritis) intermediary forms were also observed in Acalymma in cucurbita due to NFA-based herbal pesticides treatment. These findings fall in like with the observations of neem cucurbita that morphological abnormalities were recorded in Aphids due to NFA 100% dust similarly certain plant products like azadirachtin-rich fraction of nemicidin caused emergence of malformed adults of Acalymma . So it is therefore concluded that NFHP are potent biopesticides and that NFA could be an appropriate carrier in herbal pesticides. These bio-pesticides, which would be less expensive than conventional products, could be used in future.

Striped cucumber beetle and spotted cucumber beetle



Striped cucumber beetle damage to leaves and fruit

Squash bug nymphs, adults, adult and eggs and plants with symptoms of yellow vine

Squash vine borer larva and adult

Aphid colony on melons (top); (lower left) aphid on melon and (lower right) damage on watermelon

REFERENCE :

1.Abdul Kareem(2005)(Botanical dust formulation) National Symposium on Bio -pesticides, New Delhi, India, , P.59.

2.Ahmad, S., Fulekar, M.H. and Pathak, B. 2012. Impact of Coal Based Thermal Power Plant on Environment and its Mitigation Measure. *International Research Journal of Environment Sciences*, 1(4), 60-64.

3.Devaraj K. (Ovicidal(2001) action of neem seed kernel ducts on eggs of *Helicoverpa armigera*), Insect Environment , 7, 142-143.

4.Daniel Gnan kumar (1989) (A lignite flyash: A non-polluting substance for tackling pest problems) University of Agricultural Sc. Bangalore , PP-201-206.

5.G.N. Mathur (2003)(Fly-ash in the plant protection scenario of Agriculture. In third International Conference on fly-ash Utilization and disposal. Proceeding –II C.B. I P, Govt. of India N.D. P-71-80.

6.Joseph T.M., (2000) Antecedent and growth inhibitory effect of neem seem kernel, Entemon, 25, 67-70.

7.K. Udaiyan (1994) (Bio-efficiency of neem derivatives on some major pests of rice and vegetables, pestology, 14, 40-42.

8.Kalra, N., Joshi, H.C., Sharma, S.K., Harit, R.C. and Brij Kishor, 1996. Effect of fly ash incorporation on soil and crop productivity, ICAR News, 2(2), 18.

9.Kumar, V., Chandra, A. and Singh, G. Efficacy of fly-ash based bio-fertilizers vs perfected chemical fertilizers in wheat (Triticum aestivum), *International Journal of Engineering Science and Technology,* 7(2), 31-35(2010)

10.Ladwani, K. D., K. D., Ladwani, V. S., Manik and D. S. Ramteke, 2012. Impact of Industrial Effluent Discharge on Physico-Chemical Characteristics of Agricultural Soil.
International Research Journal of Environment Sciences, 1(3), 32-36.

11.McNally, D., Crowley-Parmentier, J. and Whitman, B. 2012. Trace Metal Leaching and Bioavailability of Coal-Generated Fly Ash. *International Research Journal of Environment Sciences,* 1(5), 76-80.

12.Nambirajan S. G. (2001) (Field performance of coal fly ash against pests of vegetables, and National Seminar on FA A.U. PP 42-50.

13.Pandey, V.C., Singh, J.S., Singh, R.P., Singh, N. and Yunus, M. 2011. Arsenic hazards in coal fly ash and its fate in Indian scenario. *Resource Conservation and Recycling,* 55(9), 819-835.

14.Suryawanshi, P.C., Jain, K.A., Bhardwaj, S., Chaudhari, A.B. and Yeole, T.Y 2013. Solid and Liquid Wastes: Avenues of Collection and Disposal. *International Research Journal of Environment Sciences,* 2(3), 74-77.

15.Thiyagarajan. P. (2003)(efficiency of fly-ash 100% dust against key pests of certain vegetables and fruits crop. A. U. P.95

16.VIjaya Kumar N.(2001) (Investigations on the use of lignite fly ash an insecticides) A.U. p. 253

17.Vitekari, H. N., Talele, A. P., Mane, R. G., Gaikwad, V.S. and Shah, J.V. 2012. Fly ash based biopesticides: A comprehensive review, *Biological Sciences*, 59, 173-178.