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# Effect of phytochemicals their concentration and period of exposure on mortality of Aphis craccivora Koch (Hemiptera: Aphididae)

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**Abstract**
A laboratory experiment was conducted at D.B.S.P.G. college Kanpur to study the insecticidal effect of 10 indigenous plant extracts (A. calamus, A. vasica, A. galanga, C. sativum, C. tiglium, J. curcus, S. indica, S. acmella, T. asthamatica and Neem gold) their different concentrations (0.5%, 1.0% and 2.0%) over three exposure periods (6hrs,12 hrs,24hrs) against bean Aphid, *Aphis craccivora* koch. Significant variation was recorded among plant extracts their concentrations and exposure periods. The highest mean mortality value of insect was recorded with plant extract of Neem gold (60.16%) followed by C. tiglium (59.38%), *A. vasica* (54.41%) and *T. asthmatica* (54.07%) *C. sativum* (53.55%), *A. calamus* (52.67%), *A. galanga* (52.24%), *J. curcus* (49.59%), *S. indica* (46.14%) and *S. acmella* (35.02). Likewise, 2% conc. of plants extract and 24 hrs exposure periods both were found to be most effective by achieving the highest mortality value 60.16% and 59.38% respectively. Combination effect of *Neemgold* with 2% conc ($A_{10}xB_3$). and 24hrs exposure period ($A_{10}xC_3$) exhibited highest mortality value 66.02% and 71.15% respectively. Similarly, interaction between 2%conc. with 24hrs exposure period ($B_3xC_3$) was found to be most useful by achieving 71.07% insect mortality. The cumulative performance of both combinations $A_{10}$ x $B_3$ x $C_3$ and $A_3$ x $B_3$ x $C_3$ were found to be most effective by achieving the highest mortality (83.85%.) of insect. Thus, extract of both *Neemgold as* well as A. galanga with 2% concentration over 24 hrs exposure duration may be used for achieving the highest mortality of Aphis craccivora, a serious pest of groundnut, cowpea, sorghum and vegetables in North India, further it may also be an ideal substitute for synthetic insecticides.

**Keywords:** Plant extracts, exposure period, mortality, cowpea, sorghum

## Introduction
Food and nutritional security is at most importance for the burgeoning population in the country. On an average 15-20% potential crop production is lost due to insects, pests, weeds, diseases, nematodes, rodents etc. Thus, plant protection efforts aim at minimizing the crop losses. The plant protection strategies and activities have significant importance in overall crop production programs for sustainable agriculture. The stagnant to the progressive stage by increasing the gross national product, by supplying the physical surplus in the shape of food and raw material, and by providing economy surplus which constitute the material basis for economic development. Unfortunately, a major part of our agricultural production is eaten away and destroyed mercilessly by various pest and plant diseases, pest destroys more than 1/3rd of worlds crop production and cause heavy crop losses, which can be successfully dealt with only use of the pesticides. If pesticides are not used the crop losses may rise to 50% and even in more in developing countries. Presently, at global level more than 2.3 million tons of pesticides are used annually. Seeing the hazardous effects on health as well as in ecosystem, alternate methods of pest control have received attention in the recent years. Several researches have depicted the pesticides resistance in insect and pest due to continuous use of synthetic pesticides. Thus, resistance in its term has forced us to increase the doses of pesticides; resultant, toxic hazards have reached at alarming proportion in our country. They are also involved in the process of dye manufacturing. Now, a search is being made for alternative technology of pest control which is comparatively safe, eco -friendly and equally effective.

Natural products offer better degree of selective toxicity and may form ideal substitute for synthetic pesticides.

The bean Aphid, *Aphis craccivora* (Koch) Hemiptera; Aphididae is distributed all over India, but it is serious pest of groundnut, cowpea, sorghum and vegetables in North India. (Chandel *et al* 2001) [1]. There are so many plant species present in nature, are not even touched by the insects to feed. Such plants must have some deterring chemicals which exhibit their feeding, may be used for insects –pests management. The selected plants species under this study were tested for their biological efficacy and found that they are not even touched by the target insect to feed. Therefore, they have been utilized for insect (*A. craccivora*) management, which are comparatively cheaper than synthetic insecticides.

**Material and methods**

The laboratory experiment was conducted during 2007-2008 in department of zoology D.B.S.P.G. college Kanpur. Geographically the district Kanpur is located in between latitude25.26$^0$ and 26.58$^0$ North and longitude 19.31$^0$ and 84.34$^0$ east and at an elevation of about (127.12$^0$) meter above mean sea level with semi arid sub tropical climatic condition.

The targeted Aphid of *Aphis craccivora* was collected from the groundnut, cowpea, sorghum and vegetable field of vegetable research farm Kanpur and village fattepur gohi. During the period of study the feeding habit of larvae have been noted that in cloudy weather, aphid continue to feed on upper surface of the leaves throughout the day to obtain regular supply of known aged Aphid of *Aphis craccivora* on cowpea leaves in laboratory. The food was changed daily and at maturation the aphid was provided the sand jar for pupation. The newly emerged insect (adult) was separated accordingly to their sexes and a pair of male and female was released on potted cowpea plants. The leaves having eggs pouches were seen clearly and after hatching newly hatched caterpillar were transferred to the petri dishes containing food over moist filter paper.

The plant material used in the present investigation was collected mainly from wasteland, wild area and cultivated fields. A preliminary trail was undertaken in the laboratory by crude method to see the toxicity in the form insecticidal effect against *A.craccivora* out of 25 selected plants only ten plants (A. calamus, S. indica, A. vasica, A. galanga, C. sativum, C. tiglium, J. curcus, S. acmella, T. asthamatica and Neemgold) showed the above ability, used for their biological efficacy against *A.craccivora*. The different plant parts (Rhizome, Shoots, Leaves, seeds, fruits and flowers) of ten selected plants with appropriate solvent (petroleum ether and alcohol) were used for getting their pure extract. Later on, 50ml pure benzene was added to dissolve the constituent of the materials, thus prepared the 50% stock solution and mouth of the bottles were stopped with air tight corks and kept in refrigerator. The different concentrations (0.5%, 1.0%, 2.0%) of insecticides were prepared from stock solution using benzene at solvent and triton X-100 as emulsifier then 0.5% triton X-100 was accurately measured in to large bottle, then 99.5 ml of distilled water was added and bottle was shaken well to dissolve the emulsifier. Thus emulsifiable water of 0.5 percent strength was obtained for preparation of different concentration of the extracted materials.

The insecticides of plant origin were tested by dry film technique. The spraying of insecticides was alone in glass petridises (10 cm diameter) by potter spray tower using 1ml of solution per petridises then their concentration were tested in the replication to record the mortality the spray per dises were gently shaken under an electric fan until the liquid phase evaporated leaving behind a uniform dry film of insecticide on the glass surface inside each pair of petridishes known aged ten caterpillar were released and allowed remaining there up to 2hrs later on they were transferred to the fresh perridishes containing fresh food for feeding. These petridishes were kept as such under control condition (27±2$^0$C temp. 75±5% RH) and mortality count was taken after 6, 12, 24 hours of exposure.

**Result and Discussion**

An experiment was conducted in laboratory to test the insecticidal properties of ten selected indigenous plant extract, their three concentrations over three exposure periods against bean Aphid, *Aphis craccivora, Koch.*

The mortality of mentioned pest was recorded when exposed to the *Arachis hypogea* and *Phaseolus mungo* leaves, treated with plant extract of three different concentrations (0.5%, 1.0%, 2.0%) of each treatment. The no. of adults in each petridishes were recorded in the basic percentage reduction of the adult in each petridish at the time interval of 6 hrs, 12hrs and 24 hrs respectively.

**Effect of plant extracts against bean Aphid, *Aphis craccivora*, Koch**

The ANOVA table depicted the highest significant variation among treatments, concentrations as well as exposure periods. Significant variation was also recorded with combinations of treatments over Concentrations. (A x B), treatments over exposure periods (A x C), concentrations over exposure periods (B x C) and over all combination of treatments with concentrations over exposure periods (A x B x C). Table-1 reveals the significant variation of insecticidal performance among the plant extracts. The plant extract of neemgold gave the maximum mortality by killing 60.16 percent adult of *aphis craccivora* followed by C. tiglium 59.38 percent, N. vasica 54.41 percent, T. asthmatica 54.07 percent, C. sativum 53.55 percent, A. calamus 52.67 percent, A. galanga 52.24 percent, J. curcus 49.55 percent and S.indica 46.14 percent. Least mortality value 35.02 percent was recorded with plant extract of S.acmella. Similar findings have also been reported by Sahoo and Senapati (2000) [2] assessed the efficacy of 9 insecticidal components for control of pod borer incidence in pigeon pea. for one rupee spent endosulfan gave the profit of Rs 4.70 as against Rs. 2.28,Rs 1.83, Rs. 1.00, Rs.0.74, Rs, 1.43 & Rs. 0.12 in a azactirachtin, acephate, triasophas, ginger + chilly extracts (GCE), Neem seed karnel extracts (NSKE) and ehophenprox treatments respectively. Mongan and Mahadeva (1987) [3] isolated azactirachtin, and four toxic tetranartri terpenoids from melia azadarach among them azactirachtin, showed insecticidal activity against *collosobruchus chinensis*.

Table No-2 revealed a significant variation among different concentrations of extract for insect mortality values. The highest mortality 56.66 percent was recorded with 2 percent concentration of plants extract followed by 1 percent concentration (51.19%) the least (47.37%) mortality was observed with 0.5 percent concentration of plants extract. Reed *et al*. (1982) [4] was also in confirmation of these results they found the azactirachtin and solanin as an antifeedant against spotted cucumber beetle at 0.1% concentration. Mohaptra (2001) [5] tested seven synthetic and 2 neem products against cashew nut leaf hopper, monelepta longitatarsus and reported the reduction in monocrotophos

(0.05%) showed highest reduction (73.19%) in leaf infestation of neem product, repelin (2%) and Neem gurd (2%) were found moderately effective with percentage of reduction in leaf infestation 56.70% and 59.19% respectively over control.

Likewise, duration of exposure period (Table-3) also exhibited a significant impact on mortality of nymph and adult among the three exposure periods. The highest mortality value (64.12%) of nymph and adult was recorded with 24 hrs duration followed by 12 hrs (50.24%). The least mortality of nymph and adult was recorded with 6 hrs (40.51%) duration.

Interactions values between treatments with both concentrations of extract (A x B), & duration of exposure periods (A x C) & interactions between concentrations of extract with exposure periods (B x C) as well as over all interactions among all factors (A x B x C) exhibited the significant variation in respect of morality value of insect. $A_2$ x $B_3$ combination was found to be most effective and achieved the 69.50% morality value, followed by combination of $A_{10}$ x $B_3$ (66.02%) and $A_5$ x $B_3$ (63.40%). The combination of $A_8xB_3$ exhibited the least mortality value (31.48%) (Table - 1).

Likewise, $B_2$ x $C_3$ combination was found to be most effective by scoring the highest mortality (71.07%) value followed by $B_2$ x $C_3$ (62.54%) and $B_1$ x $C_3$ (61.95%) combinations. least performance (35.97) in respect of morality value was recorded with $B_1$ x $C_1$ Combination (Table-2)

The combination of both C. tiglium and A. galangal with 24 hrs. exposure ($A_5$ x $C_3$ & $A_3$ x $C_3$) scored the highest mortality value 72.71% and 72.62%) respectively followed by combination of $A_{10}xC_3$ (71.15%). $A_8xC_1$ combination exhibited the least performance (19.86%) for mortality of insect Table-3

Highest mortality value 83.85% was equally found with both combinations $A_3$ x $B_3$ x $C_3$ and $A_{10}$ x $B_3$ x $C_3$ followed by combination of $A_2xB_3$ x $C_3$ (81.15%) and $A_5$ x $B_3$ x $C_3$ (77.71%) The combination among $A_8xB_1xC_1$ was found to be least (16.40%) effective to insect control. (Table -4)

**Table 1:** Combination Effect of Plants Extract with Their Concentrations (AXB) on mortality of *Aphis craccivora*

| | | Concentration of plant extract (%) | | | |
|---|---|---|---|---|---|
| **S. N.** | **Treatments** | **$B_1$ (0.5%)** | **$B_2$ (1.00%)** | **$B_3$ (2.00%)** | **Mean** |
| 1. | A.calamus ($A_1$) | 47.53 | 52.62 | 57.85 | 52.67 |
| 2. | A.vasica ($A_2$) | 39.46 | 54.25 | 69.50 | 54.41 |
| 3. | A.galanga ($A_3$) | 45.25 | 51.63 | 59.85 | 52.24 |
| 4. | C sativum ($A_4$) | 51.15 | 53.33 | 56.18 | 53.55 |
| 5. | C.tiglium ($A_5$) | 55.57 | 59.16 | 63.40 | 59.38 |
| 6. | J.curcus ($A_6$) | 44.28 | 50.19 | 54.31 | 49.55 |
| 7. | S.indica ($A_7$) | 43.74 | 46.20 | 48.48 | 46.14 |
| 8. | S.acmella, ($A_8$) | 39.28 | 31.48 | 34.29 | 35.02 |
| 9. | T.asthmatica ($A_9$) | 51.72 | 53.77 | 56.72 | 54.07 |
| 10. | Neemgold ($A_{10}$) | 55.71 | 58.74 | 66.02 | 60.16 |
| | Mean | 47.37 | 51.14 | 56.66 | 51.72 |
| | | A | B | | A X B |
| | SE(m) | 0.170 | 0.093 | | 0.294 |
| | SE(d) | 0.240 | 0.131 | | 0.416 |
| | CD (1%) | 0.473 | 0.259 | | 0.818 |
| | | | | | |

**Table 2:** Combination effect of different concentrations with exposure periods (B x C) on mortality of *Aphis craccivora*

| | Concentration of plant extract (%) | | | |
|---|---|---|---|---|
| **Time Periods** | **B1 0.5 (%)** | **B2 1.0 (%)** | **B3 2.0 (%)** | **Mean** |
| | | | | |
| C1 (6 hrs) | 35.97 | 41.78 | 45.13 | 40.96 |
| C2 (12 hrs) | 44.16 | 49.25 | 53.78 | 49.07 |
| C3 (24 hrs) | 61.95 | 62.54 | 71.07 | 85.19 |
| Mean | 47.37 | 51.19 | 56.66 | 51.74 |
| | | B | C | B x C |
| | SE (m) | 0.093 | 0.093 | 0.161 |
| | SE (d) | 0.131 | 0.131 | 0.228 |
| | CD (1%) | 0.259 | 0.259 | 0.449 |

**Table 3:** Combination effect of plants extracts with different exposure periods on mortality of *Aphis craccivora*

| | | Exposure Periods | | | |
|---|---|---|---|---|---|
| **S.N.** | **Treatment** | **C1 (6hrs)** | **C2 (12 hrs)** | **C3 (24 hrs)** | **Mean** |
| 1. | A.calamus ($A_1$) | 39.46 | 52.23 | 66.31 | 52.67 |
| 2. | A.vasica ($A_2$) | 48.07 | 53.36 | 61.79 | 54.41 |
| 3. | A.galanga ($A_3$) | 36.76 | 47.35 | 72.62 | 52.24 |
| 4. | C sativum ($A_4$) | 45.00 | 49.52 | 66.15 | 53.55 |
| 5. | C.tiglium ($A_5$) | 46.28 | 59.14 | 72.71 | 59.38 |
| 6. | J.curcus ($A_6$) | 44.36 | 49.49 | 54.92 | 49.59 |
| 7. | S.indica ($A_7$) | 36.34 | 43.08 | 59.00 | 46.14 |
| 8. | S.acmella, ($A_8$) | 19.86 | 32.27 | 52.93 | 35.02 |
| 9. | T.asthmatica ($A_9$) | 43.08 | 55.52 | 63.60 | 54.07 |
| 10. | Neemgold ($A_{10}$) | 48.85 | 80.48 | 71.15 | 60.60 |
| | Mean | 40.51 | 50.24 | 64.12 | 57.72 |

| | | | | |
|---|---|---|---|---|
| | | A | C | A X C |
| | SE (m) | 0.170 | 0.093 | 0.294 |
| | SE (d) | 0.240 | 0.131 | 0.416 |
| | CD (%) | 0.473 | 0.259 | 0.819 |

**Table 4:** Combination effect of plants extract with their concentrations over exposure periods (A x B x C) on mortality of *Aphis craccivora*

| | 6 Hrs ($C_1$) | | | | 12 Hrs ($C_2$) | | | | 24 Hrs ($C_3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | **0.5%($B_1$)** | **1.00%($B_2$)** | **2.00%($B_3$)** | **Mean** | **0.5%($B_1$)** | **1.00%($B_2$)** | **2.00%($B_3$)** | **Mean** | **0.5%($B_1$)** | **1.00%($B_2$)** | **2.00%($B_3$)** | **Mean** | **G. Mean** |
| A.calamus ($A_1$) | 32.22 (36.69) | 46.92 (53.30) | 63.44 (80.00) | 47.53 (56.63) | 41.15 (43.30) | 52.78 (63.40) | 63.93 (80.00) | 56.62 (62.23) | 45.00 (50.00) | 57.00 (70.40) | 71.56 (90.00) | 57.85 (70.13) | 52.67 (63.00) |
| A.vasica ($A_2$) | 32.22 (36.69) | 41.15 (45.30) | 45.00 (50.00) | 39.46 (43.30) | 50.77 (60.00) | 52.78 (63.40) | 59.22 (73.50) | 54.269 (65.73) | 61.22 (76.80) | 66.15 (83.70) | 81.15 (97.60) | 69.51 (86.03) | 50.41 (60.00) |
| A.galanga ($A_3$) | 30.22 (33.30) | 43.08 (46.60) | 62.44 (79.98) | 45.25 (53.30) | 31.15 (39.90) | 48.85 (56.70) | 71.56 (90.00) | 52.52 (62.20) | 42.92 (46.20) | 52.78 (63.40) | 83.85 (98.90) | 59.85 (69.57) | 52.24 (61.90) |
| C sativum ($A_4$) | 43.08 (46.70) | 46.92 (53.40) | 63.44 (80.00) | 51.14 (60.03) | 45.00 (50.00) | 48.85 (56.70) | 66..15 (83.70) | 53.33 (63.47) | 46.92 (50.48) | 52.28 (63.49) | 68.85 (87.00) | 56.18 (66.93) | 53.55 (63.48) |
| C.tiglium ($A_5$) | 43.08 (46.70) | 54.78 (66.70) | 68.85 (87.00) | 55.57 (66.77) | 46.92 (53.40) | 59.01 (73.50) | 71.56 (90.00) | 59.16 (72.30) | 48.85 (56.70) | 63.63 (80.70) | 77.71 (95.50) | 63.40 (77.63) | 59.38 (73.23) |
| J.curcus ($A_6$) | 41.15 (45.30) | 40.92 (46.40) | 50.70 (60.00) | 44.29 (50.50) | 45.00 (50.00) | 52.78 (63.40) | 52.78 (63.40) | 50.18 (58.93) | 46.92 (53.40) | 54.78 (66.70) | 61.22 (76.80) | 54.30 (65.63) | 49.59 (58.35) |
| S.indica ($A_7$) | 33.30 (35.20) | 41.15 (45.30) | 56.76 (70.00) | 43.74 (50.17) | 36.50 (37.22) | 43.08 (46.70) | 593.01 (73.40) | 46.19 (52.44) | 39.23 (40.00) | 45.00 (50.00) | 61.22 (76.80) | 48.48 (55.60) | 46.14 (52.74) |
| S.acmella, ($A_8$) | 16.40 (23.85) | 26.90 (30.90) | 74.56 (86.89) | 39.25 (44.95) | 20.00 (26.56) | 33.30 (35.22) | 41.15 (45.10) | 31.48 (35.63) | 23.20 (28.78) | 36.60 (39.22) | 43.08 (46.60) | 34.24 (37.536) | 35.02 (39.37) |
| T.asthmatica ($A_9$) | 41.15 (45.30) | 52.78 (63.40) | 61.22 (76.80) | 51.72 (61.83) | 43.08 (46.60) | 54.78 (66.70) | 63.44 (80.00) | 53.70 (64.43) | 45.00 (50.00) | 59.01 (73.50) | 66.15 (63.20) | 56.72 (69.10) | 54.02 (65.12) |
| Neemgold ($A_{10}$) | 46.92 (53.40) | 56.79 (70.00) | 63.44 (80.00) | 55.71 (67.80) | 48.82 (56.70) | 61.22 (76.80) | 66.50 (83.70) | 58.86 (72.47) | 50.77 (60.00) | 64.44 (80.00) | 83.85 (98.90) | 66.02 (79.43) | 60.28 (63.23) |
| Mean | | | | 43.37 (55.23) | | | | 51.42 (62.78) | | | | 56.66 (67.76) | 51.74 (57.56) |

**Table 5:** Anova

| Source | D.F. | S.S. | M.S.S. | F. Cal | Significance |
|---|---|---|---|---|---|
| Factor A | 9 | 10380.250 | 1153.361 | 1482.231 | 0.0000 |
| Factor B | 2 | 34.79.625 | 1739.812 | 2235.904 | 0.0000 |
| Factor A X B | 18 | 3497.500 | 194.306 | 249.710 | 0.0000 |
| Factor C | 2 | 23699.938 | 11849.969 | 15228.876 | 0.0000 |
| Factor A X C | 18 | 3302.438 | 183.469 | 235.783 | 0.0000 |
| Factor B X C | 4 | 319.250 | 79.812 | 102.570 | 0.0000 |
| Factor A X B X C | 36 | 2270.750 | 63.076 | 81.062 | 0.0000 |
| Error | 180 | 14.062 | 0.778 | | 0.0000 |
| Total | 269 | 47089.812 | | | |

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