ABSTRACT

PUSH-PULL STRATEGIES FOR THE MANAGEMENT OF DIAMOND BACK MOTH (DBM), *PLUTELLA XYLOSTELLA* (Linn.) IN CRUCIFEROUS VEGETABLES

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Laboratory bioassays were conducted to evaluate the bioactivity of different solvent crude extracts of *Lantana* leaf extracts against *Plutella xylostella* (Linn.) larvae. Fresh cabbage or cauliflower leaf discs sprayed with different solvent crude extracts of *Lantana* leaf at six concentrations (1, 2, 4, 6, 8 and 10% w/v), were assayed for ovicidal, larvicidal, pupal mortality, antifeedant and repellent effects against 2nd, 3rd and 4th instar larvae of *P. xylostella* in a completely randomized design (CRD) with 3 replicates per treatment. Solvents and neem oil at same concentrations were included as negative and positive controls, respectively. Among the crude extracts, hexane exhibited the highest egg mortality (52.66-95.83%) after 72h of treatment followed by petroleum ether, acetone and ethyl acetate extracts (21.43-90.83%), ethanol (61.21-92.12%) methanol (6.66-57.22%) and aqueous extracts (12.50-54.60%). Neem oil used as a standard check recorded 20.00-91.11 per cent egg mortality. The results of experiments at 10 per cent revealed that after 72 and 48h, the highest larval mortality of 93.33 and 86.67 per cent recorded in second instar larvae respectively.

The same concentrations after 24, 48 and 72h, recorded 86.67, 93.33 and 99.88 in third instar larvae and 80.00, 96.67 and 99.88 per cent mortality against fourth instar larvae respectively. The same trend was observed in antifeedant and repellency test also.

The effective persistence period was up to 10 days recorded in third instars of PTI of 559.90, 701.44 and 846.00 at 6, 8 and 10 per cent concentrations with mortalities against 39.99, 50.10 and 60.43 per cent respectively. The same concentrations gave highest mortality in second instar for 3 days after spraying (82.14; 83.00 and 96.43%), whereas, the effect of one and two per cent never attained even 50 per cent mortality.

In GC-MS study of crude extracts of *Lantana* leaves recorded six to nineteen important components *viz.,*caryophyllene, caryophyllene oxide, selina-6-en-4-ol, 2-hexadecen-1-ol, hexatriacontane, tetrapentacontane, 1,3-cyclohexadiene-1-carboxaldehyde, 6-S-2,3,8,8-tetramethyltricyclo [5.2.2.0(1,6)]undec-2-ene, benzene, 1,2-Benzenedicarboxylic acid, mono (2-ethylhexyl) ester, 2,6,10-Trimethyl,14-ethylene-14-pentadecne, 3-nonanone, phytol and squalene were identified in various crude extracts.

Cole vegetables intercropped with non-crucifer host plants like coriander, marigold, tomato, onion, radish and neem oil recorded less incidence of diamondback moth per five plants. Among them marigold as intercrop was superior in reduction of diamondback moth (3.19; 3.64) population incidence followed by coriander (3.21; 1.85), tomato (4.50; 1.94), onion (4.42; 1.98), and radish (5.00). Onion, neem oil (4.96; 1.71) and tomato + cauliflower were on par statistically in both cauliflower and cabbage intercropping systems. However, all the intercropped systems harboured more diamondback moth than plots maintained as per farmer practices (1.31; 1.06).

The natural enemy populations were more in intercropped plots than farmer practices in both vadavalli and pooluvapatti field trials of cauliflower and cabbage, respectively during 2014-15. The mean number of parasitoid pupae and coccinellid beetle were found in plots intercropped with mustard was 2.81; 8.66 per five plants followed by coriander (2.66; 3.42 nos.) and french beans (2.56; 14.09 nos.) per five plants which was significantly higher than farmer practices (0.61; 2.92 per five plants) and sole crop cabbage alone (1.32; 7.17 per five plants) during 2015-16 in Annanagar, Ooty. Finally it is suggested that coriander and marigold may be a component in push- pull IPM technology for Coimbatore and mustard and coriander for Ooty.

Repellent components namely 1-(2-trimethylsiloxy-1,1-dideuter- iovinyl)-4-trimethyl siloxy- benzene (27.52%), 3-(Maleimido-2-yl)-1-methyl-2-(1-methylindol-2-yl) indole (11.10); 3,7,11,15-Tetramethyl-2- hexadecen-1-ol (2.89) and (-)Caryophyllene oxide (1.58%), 13-Docosenamide, (Z) - (22.77), Nonahexacontanoic acid (CAS) (17.56%), 2-Bromotetradecanoic acid (5.99%) and Dimethyl 2-Methoxymethyl benzene-1, 3-dicarboxylate (0.62%) present in onion and leaf extracts of marigold identified were 9-Octadecenamide, (Z)- (CAS) and deoxyspergualin (23.02%), 2-Nonadecanone and Oxirane, [(hexadecyloxy)methyl] (17.33%), Neophytadiene (5.21%), 1-hydroxy-2-phenyl-3-ethoxyyl-6-azaindole (4.11%) and least area per cent recorded trans-Caryophyllene (1.24%), (-)-Caryophyllene oxide 93.37%) of inter cropping sample. Attraction components from coriander leaf (hybrid) extracts were identified to be 9-Octadecenamide (30.81%), 2,2-Dichloro-N-(2-phenylmethoxyimino ethyl) -N-(2-propenyl) acetamide (8.99%), (E)-Ethyl 2-benzyl-3-(4'-phenylphenyl)but-2-enoate (2.55%), (S)-(1-Methylbutyl) (E)-2,4-dimethyl-2-pentenoate (2.50%) and least quantum recorded in hexadecane, 2,6,11,15-tetra methyl- (CAS) (0.69%) N-(2-Methyl-2H-tetrazol-5-yl)-acetamide (0.77%).

Traps baited with a single plant volatile compound (AITC) have significant mean moth attraction numbers were Ph + AITC @ 50 µl (63.59, 70.04), Ph + AITC @ 75 µl (73.62, 90.40), Ph + AITC @ 100 µl (106.48, 89.69) and followed by synthetic lure alone (22.09, 29.26), water pan trap-lure on top lid (9.18, 7.20) and poor attraction observed in sleeve trap (2.44, 2.08) and AITC alone (5.39, 2.98) respectively on cauliflower and cabbage system at Coimbatore during 2014-2015. Pooled mean data on the attraction efficiency (Table 76) revealed that Ph+ AITC @ 50 µl, per septa recorded 70.04, 6.80; 63.59, 8.40; 23.19, 7.80 male and female moths in cabbage (CBE), cauliflower (CBE) and cabbage (Ooty) respectively. The same increased pattern was observed in 75, 100 µl per septa of irrespective of the locations.

The per cent reduction of *P. xylostella* population over control was maximum in plots with Push-Pull strategies (77.74, 68.92 and 54.88%) than the farmer's practice (76.87, 65.30 and 34.22%). Maximum yield was recorded from plots with Push-Pull strategies (34.72, 29.96 and 39.74 t/ha) as compared to untreated check (24.56, 17.97 and 23.79 t/ha) of cabbage (CBE), cauliflower (CBE) and cabbage in Kothagiri, Ooty

respectively. In a crop diversification system, like coriander or marigold or onion with mustard were result in poor quality or dilution of cauliflower/cabbage volatiles. This diluted or mixed odor may signal as poor quality host to the insect pest leading to repellent behavior. In polyculture, the odors released by some plants may mask the effect of those released by other plants. The plant offers hope as a potential cost-effective and environmentally benign antifeedant for diamondback moth control in cole vegetable ecosystem.