International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(2): 88-92
Received: 14-11-2023
Accepted: 18-12-2023

Vinay Kumar MM
HREC, Devihosur, Haveri, Karnataka, India

PS Ajjappalavar
HREC, Devihosur, Haveri, Karnataka, India

Ravikumar B
HREC, Devihosur, Haveri, Karnataka, India

M Abdul Kareem
HREC, Sirsi, Karnataka, India

M Narayana Bhat
National Research Centre for Integrated Pest Management (ICAR-NCIPM), New Delhi, India

S Vennila
National Research Centre for Integrated Pest Management (ICAR-NCIPM), New Delhi, India

Ajay Kumar Singh
National Research Centre for Integrated Pest Management (ICAR-NCIPM), New Delhi, India

Corresponding Author:
Vinay Kumar MM
HREC, Devihosur, Haveri, Karnataka, India

The demonstration and study on evaluation of integrated pest management and non-integrated pest management methods in chilli in north transition zone of Karnataka

Vinay Kumar MM, PS Ajjappalavar, Ravikumar B, M Abdul Kareem, M Narayana Bhat, S Vennila and Ajay Kumar Singh

DOI: https://doi.org/10.33545/2618060X.2024.v7.i2Sb.338

Abstract
IPM trial in chilli was carried out in seven acres for three successive years during 2020 to 2022 at Devihosur, Karnataka. IPM interventions of bio-pesticides, traps and lures, border crop with maize, planting marigold/flowering plants and application of need based chemical pesticides helped in bringing down fruit borers, sucking pests and major diseases to increase the crop yield at Devihosur, Haveri, Karnataka. Observations on pest population and leaf curl index was recorded in weekly interval. Seasonal average (2020, 2021 and 2022) of thrips population was recorded 1.38 and 1.77 thrips/leaf, 0.56 and 0.85 mites/leaf, 0.63 and 0.8 aphids/leaf, 2.4 and 3.01 damaged fruit/plant similarly 24.16% and 30.8% murda complex disease were recorded from IPM and non IPM plots respectively. Were as natural enemy population also found higher number in IPM plot as compared to non IPM plot (0.5, 0.29 Coccinellids/plant and 0.52, 0.34 Spider/plant from IPM and non IPM respectively). B: C ratio recorded 1.68 and 1.46 from IPM and non IPM respectively.

Keywords: IPM, Murda complex, coccinellids, B:C ratio, leaf curl index

Introduction
Chilli (*Capsicum annum*) also known as 'red pepper' is traditionally used as vegetable, spice, condiment and also used in preparation of sauces and pickles and even used for value addition in pharmaceuticals, cosmetics and beverages. Despite several technology interventions, chilli (green) and chilli (dry) productivity is low (8.45 and 2.49 t/ha) compared to world average of 17.46 and 2.57 t/ha respectively (Behera *et al*., 2022) [2]. There are so many limiting factors for the production of chilli includes pests like fruit borers and sucking pests and disease like anthracnose, powdery mildew and murda complex. In chilli growing traditional regions of Haveri, Gadag and Dharwad farmers facing mites, thrips, aphid, murda complex, powdery mildew and die back problems, which appear right from nursery till crop maturity. Under favourable conditions, sucking pests and diseases account for > 50% yield reduction. It is not uncommon to see farmers in irrigated chilli resorting to 25-40 rounds of chemical sprays in a single season (Anon, 2011) [1]. This is particularly true during the last two decades and the frequency is still on the rise. Injudicious application of chemical pesticides to manage these pests has only compounded the problem at various levels. Indiscriminate use of synthetic pesticides causes environmental effects such as destruction of natural enemies, effect on non-target organisms, secondary pest outbreaks and pesticide residues in food and in environment. For all these problems Integrated Pest Management (IPM) practices offer better solution to manage major pests with least damage to the environment.

Materials and Methods
IPM validation trial in chilli was carried out during spring summer seasons of 2020 to 2022 by Farmers' driven/participatory approach in Devihosur, Karnataka in in seven acres covering

seven progressive chilli farming families. Based on baseline survey on socio-economic status, pest scenario, pesticide sprays, average yield and constraints, IPM module was synthesised using ICAR-NCIPM and UHS Bagalkot recommendations and scientific literature on pest management in chilli. Major IPM interventions were seed treatment with *Trichoderma harzianum* @ 10 g/kg seed; raised nursery beds about 10 cm above ground level; covering nursery bed with nylon mesh of 40-50 micron mesh; destruct previous crop residues, weeds etc.; levelling main land avoiding water-stagnation; applying vermi-compost and neem-cake at the time of planting; *T. harzianum* @ 2 kg/acre application through enriched well rotten FYM (1 ton/acre); Seedling nipping five days before transplanting; growing maize around chilli field as a barrier crop; planting marigold as trap crop after every 18 rows of chili lines; install yellow and blue sticky traps @ 5/acre to manage sucking pests like white fly and thrips; spray azadirachtin based neem oil 10,000 ppm @ 2 ml/l in the initial stages of pest infestation; spraying of *Beauveria bassiana* @ 5 g/l against black thrips (third year trial); rogue out and bury murda infested plants in the early stages; erection of pheromone traps @ 5/ acre to manage *Helicoverpa armigera* and apply need based application of label claim pesticides against major pests; spray label claim pesticides need based against fruit borer (ETL 1 larva/plant or 1 damaged fruit per plant), thrips (ETL 2 thrips/leaf), whitefly (ETL 4-5/leaf), mites (ETL 1 yellow mite/leaf) following appropriate waiting period (wp). Some of the label claim insecticides are fenpropathrin 30 EC @ 0.033% against thrips, whitefly and mite (7 days of waiting period); spinosad 45 SC @ 0.032% against fruit borer and thrips (3 days of waiting period); emamectin benzoate 5 SG @ 0.04% against fruit borer and mite (3 days of waiting period); diafenthiuron 50 WP @ 0.08 to 0.12% against mite (3 days of waiting period); spinetoram 11.7 SC @ 0.1 to 0.11% against fruit borer (7 days waiting period) and Similarly, some of the label claim fungicides are applied like captan 75 WP @ 0.25% against damping off; copper oxychloride 50 WP @ 0.25 - 0.33% against fruit rot and azoxystrobin 11% + tebuconazole 18.3% W/W SC @ 0.1 - 0.12% against powdery mildew and fruit rot (5 days waiting period); after the harvesting the land was ploughed and harrowed and cultivated the field to expose cutworms, root grubs to natural enemies and high temperature. And we can preserve and encourage natural enemies such as coccinellids and spiders by limited and judicious use of chemical pesticides.

Observations were made at 7 days interval as per standard procedure. The sucking pests like Thrips, mites, Whitefly and Aphids were counted from three fully opened top, middle and bottom leaves with the help of 10 X hand lens from five randomly selected plants/spot and five such spots/field were selected. Beneficial insect population particularly predatory coccinellids and spiders were recorded by counting the numbers/plant in five spots with five plants/spot in a field. Whereas, for fruit borer, number of damaged fruits/50 fruits/spot and such five spots/field was recorded and converted into percent incidence. For recording powdery mildew, die back and murda complex severity, 0-5 scale was followed where 0= No symptoms; 1= 10% leaves with lesions & minimal defoliation and 5= 90% leaves with lesions with very heavy defoliation for powdery mildew; 1= up to 5% of area of plant infected, for die back; 1= 0-5% curling and clearing of upper leaves and 5=100% curling and deformed small leaves, stunted plant growth without flowering for murda complex. Percent disease index was calculated by following the methods of Wheeler (1969) [13]. AUDPC was also calculated (Campbell and Maden, 1990) [3]. Yield was recorded at each harvest and gross income was calculated based on the prevailing market price. Number of pesticide spray, cost of cultivation including pesticides, and yield B: C ratio was calculated.

Results and Discussion

Thrips scenario in IPM and non IPM fields of chilli recorded for three years, the average population of thrips recorded 0.8, 1 and 2.35 thrips/leaf (ranged 0.2 to 1.6, 0.49-2.25 and 1.8-3 thrips/leaf) during 2022 the incidence of black thrips was also recorded average of 1.26 thrips/leaf (ranged from 0.9-1.9 thrips/plant). Similarly, in non IPM average population of thrips were recorded 1.3, 1.25 and 2.77/leaf (ranged from 0.3-2.3, 0.7-2.1 and 2.1-4.3 thrips/leaf), during third year the average black thrips incidence was recorded 1.74 thrips/leaf (range between 1.1-3.4 thrips/leaf). Thrips population reaching ETL was less in IPM during 2020, 2021 and 2022 as compared to non IPM during the same period respectively. Thrips in IPM fields was kept under check by blue sticky traps and need based application of chemical pesticides. Role of blue sticky traps in managing thrips is well known (Sridhar and Naik, 2015) [11]. Mites' population recorded 0.4, 0.66 and 0.62 mites/leaf (ranged 0.2-0.9, 0.2-1.05 and 0.1-0.9 mites/leaf) while in non IPM 0.7, 0.86 and 1.0 mites/leaf (ranged from 0.1-1.6, 0.29-1.23 and 0.2-1.5 mites/leaf) further, Mites crossed ETL 0, 1, 0 and 1, 2 and 4 times in IPM and non IPM respectively. With respect to the aphids 1, 0.26 and 0 aphids/leaf (ranged 0.4-2.7, 0.05-0.26 aphid/leaf) and the average population of aphids in non IPM were recorded 0.8 and 0.8 aphids/leaf (ranged from 0.1-2.6 aphids/leaf) were recorded, average whitefly population was recorded 0.7, 0.7 and 0.7/leaf (ranged 0.2-1.7, 0.2-1.7 and 0.5-1.2 whitefly/leaf) whereas, in non IPM the average population of whitefly 0.7, 0.77 and 0.73 whitefly/leaf (ranged between 0-1.8, 0.04-0.77 and 0.4-1.4 whitefly/leaf). even though whitefly did not cross ETL, it serves as vector for leaf curl disease. At the initial stages of sucking pests, neem oil has been used in IPM which has multisite action including antifeedant, oviposition deterrent, lethal insect growth inhibitors (Kaur *et al*., 2001, Halder and Banik 2013) [8, 5]. Yellow sticky traps in IPM brought down whitefly population which is in agreement with earlier report (Delia *et al*., 2013) [4]. Similarly, fruit borer incidence recorded 2.5, 4.13 and 0.57 fruits/plant (ranged 1.3-3.4, 3.2-5.2 and 0.06-0.9 fruits/plant) and in non IPM The average fruit borer damage was recorded 3.7, 4.54 and 0.79 fruits/plant (ranged from 2.7-4.4, 3.8-5.3 and 0.04-1.4 fruits/plant).and the population was not crossed ETL with maximum in IPM during the year 2020, 2021 and 2022 respectively (Table 1).

The natural enemy like coccinellids were recorded average population of 0.43 and 0.58 coccinellids/plant (ranged from 0.3-0.54 and 0.22-1.18 coccinellids/plant), whereas 0.48 and 0.56 spiders/plant (average of 0.36-0.62 and 0.38-0.78 spiders/plant) during 2021 and 2022 respectively. While in non IPM plots, coccinellids were recorded 0.28 and 0.31 coccinellids/plant (ranged from 0.14-0.38 and 0.1-0.5 coccinellids/plant), whereas 0.34 and 0.35 spiders/plant (average of 0.26-0.46 and 0.06-0.64 spiders/plant) during 2021 and 2022 respectively. Increased population of natural enemies particularly spiders and coccinellids in IPM were earlier recorded (Halder *et al*., 2020 and Sardana *et al*., 2012) [6, 9] in bottle gourd ecosystem (Fig 1).

Table 1: Pest scenario in IPM and non IPM fields of chilli

IPM											
year	**Thrips/leaf**	**Mite/leaf**	**Aphid/leaf**	**Whitefly/leaf**	**Damaged Fruit/Plant**	**Black thrips/Plant (Leaf, Flower)**	**Coccinellids/plant**	**Spiders/plant**	**% incidence of Powdery mildew**	**% incidence of die back**	***Murda* complex severity%**
2020	0.8 (0.2-1.6)	0.4 (0.2-0.9)	1.0 (0.4-2.7)	0.7 (0.2-1.7)	2.5 (1.3-3.4)	0	0	0	35.3 (1034*)	24.5 (771*)	35.2 (1391*)
2021	1.0 (0.49-2.25)	0.66 (0.2-1.05)	0.26 (0.05-0.26)	0.7 (0.2-1.7)	4.13 (3.2-5.2)	0	0.43 (0.3-0.54)	0.48 (0.36-0.62)	12.3 (408*)	19.5 (721*)	14.8 (831*)
2022	2.35 (1.8-3.0)	0.62 (0.1-0.9)	0	0.7 (0.5-1.2)	0.57 (0.06-0.9)	1.26 (0.9-1.9)	0.58 (0.22-1.18	0.56 (0.38-0.78)	25.2 (906*)	20.5 (1237*)	22.5 (716.5*)
Avg	1.38	0.56	0.42	0.70	2.40	0.42	0.34	0.35	24.27	21.50	24.17
Non IPM											
2020	1.3 (0.3-2.3)	0.7 (0.1-1.6)	0.8 (0.1-2.6)	0.7 (0-1.8)	3.7 (2.7-4.4)	0	0	0	41.9 (1347*)	30.9 (1255*)	40.2 (1750*)
2021	1.25 (0.7-2.1)	0.86 (0.29-1.23)	0.8 (0.1-2.6)	0.77 (0.04-0.77)	4.54 (3.8-5.3)	0	0.28 (0.14-0.38)	0.34 (0.26-0.46)	19.1 (558*)	25.5 (872*)	20.7 (1318*)

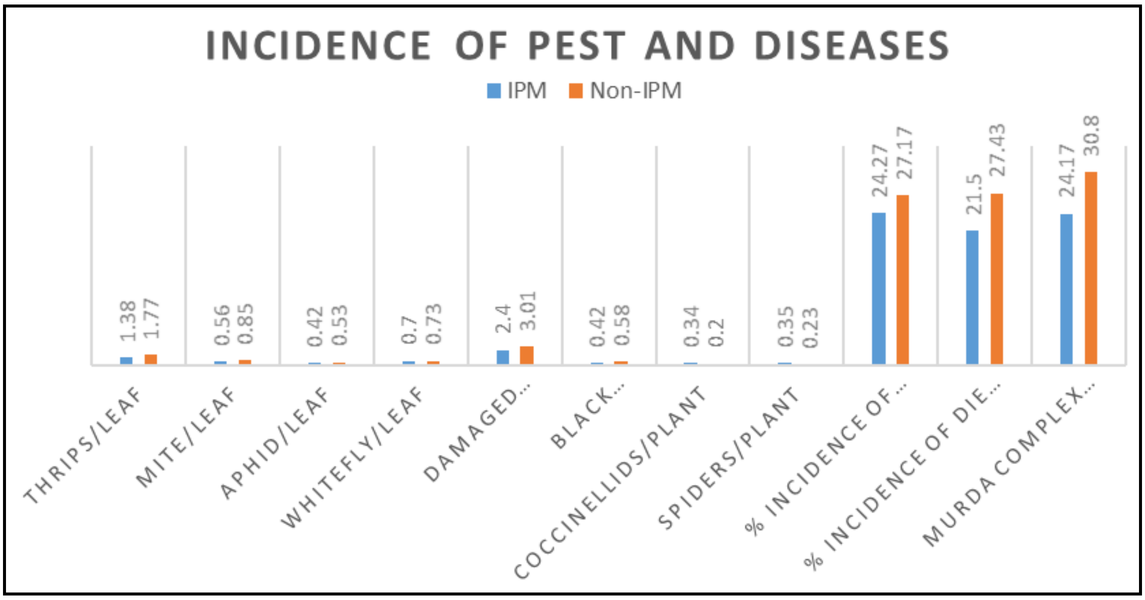

Fig 1: Pest scenario in IPM and non IPM fields of chilli

Whereas, average powdery mildew percent disease incidence was recorded 35.3% (1034 AUDPC), 12.3% (408 AUDPC) and 25.2% (906 AUDPC), die back disease incidence was recorded 24.5% (771 AUDPC), 19.5% (721 AUDPC) and 20.5% (1237 AUDPC), similarly percent murda complex severity was recorded 35.2% (1391 AUDPC), 14.8% (831 AUDPC) and 22.5% (716.5 AUDPC) during the year 2020, 2021 and 2023 from the IPM adopted plots respectively. Whereas, in the non IPM recorded incidence of powdery mildew percent disease 41.9% (1347 AUDPC), 19.1% (558 AUDPC) and 20.5% (685 AUDPC), die back disease incidence was recorded 30.9% (1255 AUDPC), 25.5% (872 AUDPC) and 25.8% (1483 AUDPC). Further, percent murda complex severity was recorded 40.2% (1750 AUDPC), 20.7% (1318 AUDPC) and 31.5% (983.6 AUDPC) during the year 2020, 2021 and 2023 from the non IPM adopted experiment respectively. The findings of present investigations are in conformity with Tatagar *et al.*, 2011 [12]. Reduced murda complex in IPM due to border crops with neem-based pesticide application and difenthiuron 50 WP has been recorded earlier.

The economics of IPM and non IPM was calculated and recorded that, the average number of sprays are 4, 6.4 and 8.6 during 2020,2021 and 2022 respectively in IPM plots and number of sprays are more i.e., 7,8.4 and 11.6 sprays in non IPM plots during 2020, 2021 and 2022 respectively. Number of pesticide sprays were four and seven in IPM with cocktail mixture of seven and 144 in IPM and non IPM respectively in 2020. During 2021 and 2022 number of pesticide sprays were 6.4 and 8.6 IPM and 8.4 and 11.6 in non IPM respectively in 2022. Maximum (25.5) cocktail mixture of pesticides was recorded in 2022 closely followed by 22.4 in non IPM in 2021. During the same period, IPM recorded 12.8 and 13.2 cocktail mixture of pesticides. ETL based application of pesticides followed in IPM allows need-based application of pesticides avoiding injudicious use of chemical pesticides. Use of cocktail mixture of 2-3 non label claim chemical pesticides and spurious plant boosters guided by local dealers is common in chili cultivation. Nagulananthan *et al.*, (2021) [14] also reported that chilli growers often contact local dealers and spray cocktail mixture of pesticides. Due to COVID, both harvesting and marketing was affected in 2020 with the result only 1.55 t/acre and 0.85 t/acre was recorded in IPM and non IPM respectively.

B: C ratio was also low 0.46 and 0.25 in IPM and non IPM respectively due to low market price. During 2021 and 2022, IPM recorded 6.69 and 7.08 t/are while non IPM recorded 6.4 and 6.67 t/acre respectively. B: C ratio was high (1.95 and 2.63) in IPM compared to 1.86 and 2.29 recorded in non IPM during 2021 and 2022. Higher B:C ratio was also reported earlier in various vegetable crops (Halder *et al*., 2022, Sardana *et al*., 2022) [7, 10]. At the end of the IPM trial, IPM farmers were able to identify the sucking pests, natural enemies and role of bio-pesticides, lures and traps in managing major pests of chili (Table 2).

Table 2: Economics of IPM and non IPM in chilli

parameters	IPM				Non IPM			
	2020	2021	2022	Avg	2020	2021	2022	Avg
No. of sprays (mixture)	4 (7*)	6.4 (12.8*)	8.6 (13.2*)	6.33 (11*)	7 (14*)	8.4 (22.4*)	11.6 (25.5*)	9 (20.63*)
Cost of plant protection including labor	4,380	11,463	14,163	10,002.00	7,509	13,836	19,515	13,620
Cost of cultivation	59,659	78,169	82,456	73,428.00	49,259	79,092	85,621	71,324
Yield t/acre	2	6.69	7.08	5.10	0.85	6.4	6.67	4.64
Gross return	27,322	1,52,750	2,17,020	1,32,364.00	12,349	1,47,800	1,96,310	1,18,819.7
B: ratio	1:0.46	1: 1.95	1: 2.63	0.04	1:0.25	1:1.86	1:2.29	0.043

*Cocktail mixture of pesticides

Chili IFC was developed using Core Java and android software available online as open resources.

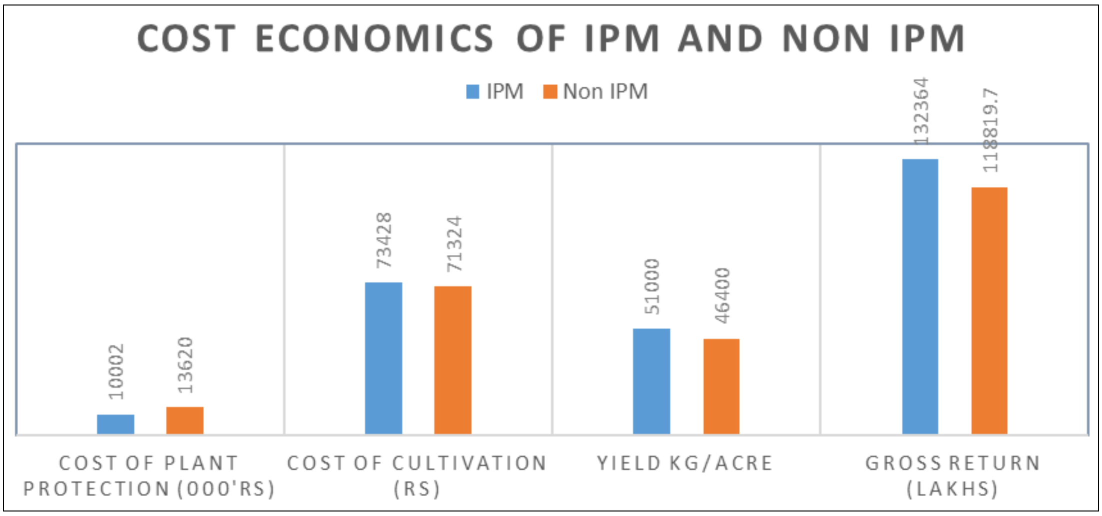

Fig 2: Economics of IPM and non IPM in chilli

Conclusion

The excessive use of chemical pesticides led to chemical residues on the fruits and vegetables and a reluctance of consumers to vegetables, as well as have greater pressure on the environment and also economic burden on farmer so, the results of the experiment may give better option for integrated approach for the pest and disease management. The chilli crop affected by many pests and diseases and they are highly influenced by the weather conditions. Moreover, the important thing is to convince the farmer to use only need based sprays which will be succeeded along with the IPM components; hence, integrated pest management approach is the best way for checking the pest and disease incidence. Because these integrated pest and disease management methods are eco-friendly and also increase the income of the farmer by reducing the cost of plant protection operations. Hence, based on all these points we can conclude that, IPM approach is better than non IPM methods (Fig 2).

References

1. Anon. Integrated Pest management in chilli, tomato, onion, and tomato crops. ICRISAT; c2011. p. 4.
2. Behera TK, Kumar R, Chaubey, Das H, Reddy BR, Nagendran K. Fifty years of AICRP on vegetable crops for sustainable development. ICAR-IIVR, Varanasi; 2022. p. 4.
3. Campbell CL, Madden LV. Introduction to plant disease epidemiology. New York: Wiley; c1990.
4. Delia M, Zevallos P, Vanninen I. Yellow sticky trap for decision making in whitefly management: What has been achieved. Crop Prot. 2013;47:74-84.
5. Halder J, Banik B. Botanicals in crop protection. In: Banik S, editor. Concepts in Crop Protection; c2013. p. 335-72.
6. Halder J, Sardana HR, Pandey MK, Nagendran K, Bhat MN. Synthesis and validation IPM technology and its economic analysis for bottle gourd (*Lagenaria siceraria*). Indian J Agric Sci. 2020;90:341-45.
7. Halder J, Sardana HR, Pandey MK, Meena BR, Bhat MN. Synthesis and area-wide validation of IPM technology and its economic analysis for eggplant (*Solanum melongena*). Indian J Agric Sci. 2022;92:1124-1128.
8. Kaur JJ, Rao DK, Sahgal SS, Seth RK. Effect of hexane extract of neem seed kernel on development and reproduction behavior of Spodoptera litura. Ann Plant Prot Sci. 2001;9:171-78.
9. Sardana HR, Bhat MN. Farmers' centred approach for area-wide implementation of sustainable IPM technology and economic analysis of onion (*Allium cepa*) during rabi season. Indian J Agric Sci. 2017;87:83-86.
10. Sardana HR, Bhat MN, Singh N, Halder J. On-farm implementation of sustainable IPM technology and its economic analysis for bitter gourd involving Farmers centered approach in Haryana; c2022.
11. Sridhar V, Onkar Naik S. Efficacy of color sticky traps for

monitoring chilli thrips, Scirtothrips dorsalis Hood (Thysanoptera: Thripidae) on rose. Pest Manag Hort Ecosyst. 2015;21:101-103.
12. Tatagar MH, Awaknavar JS, Giraddi RS, Mohankumar HD, Mallapur CP, Kataraki PA. Role of border crop for the management of chilli leaf curl caused due to thrips, Scirtothrips dorsalis (Hood) and mites, *Polyphagotarsonemus latus* (Banks). Karnataka J Agric Sci. 2011;24:294-299.
13. Wheeler BEJ. An introduction to plant diseases. London: John Wiley and Sons Ltd.; c1969.
14. Nagulananthan M, Ravi G, Balakrishnan N, Raja DL. Pesticide use behavior of chilli growing farmers in Southern districts of Tamil Nadu; c2021.