SKUAST Jammu

Significant Technology Developed




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Division of Entomology

The Division of Entomology has developed and validated pest management practices in major crops of Jammu with special reference to location specific strategies for Basmati rice, off-season tomato and maize. Besides, Low cost and economically feasible control measures for termites, cutworm, grasshoppers and paddy leaf folder and Anar butterfly for resource poor farmers of Jammu has also been developed and validated.

Technology 1
Management of Grasshoppers

Methodology

Field trials were conducted to evaluate three different modules for the management of grasshopper. The experiments were carried out at Research farm, Chatha, SKUAST-Jammu. The land preparation, seedling rate, fertilizer doses, irrigation and other cultural operations were performed as per package of practices.

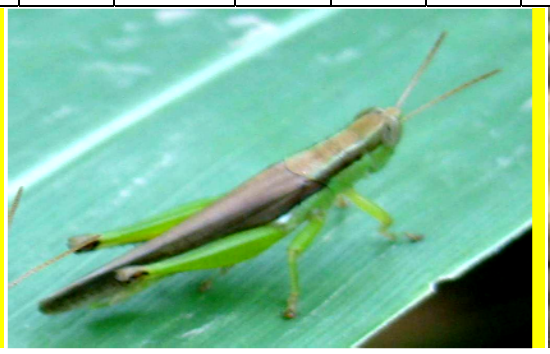
Day before Transplanting	21 DAT*	42 DAT	63 DAT
Seed treatment with imidacloprid 30.5% SC @ 5 g kg^{-1} seed at nursery sowing. Dusting on bunds.	Chloropyriphos dust 1.5% @ 10 kg ha^{-1}	Cartap hydrochloride 4G @ 20 kg ha^{-1}	Foliar application of diflubenzuron 25% WP @ 600 g ha^{-1}

***DAT –Day after treatment**

Table 1:Evaluation of IPM module for the management of grasshopper

No. of hopper quadrat $^{-1}$											
PTC (20DAT)	**(22 DAT)**	**(28 DAT)**	**(35 DAT)**	**PTC (41DAT)**	**(43 DAT)**	**(49 DAT)**	**(56 DAT)**	**PTC (62DAT)**	**(64 DAT)**	**(70 DAT)**	**(77 DAT)**
Chloropyriphos dust 1.5% at 21 DAT @ 10 kg ha^{-1}				**Cartap hydrochloride 4G was broadcasted in standing crop at 42 DAT @ 20 kg ha^{-1}**				**Foliar application of diflubenzunon 25% WP at 63 DAT @ 600gm ha^{-1}.**			
21.500 ± 0.725	**20.400 ± 0.579**	**17.500 ± 0.851**	**18.000 ± 0.822**	**19.100 ± 0.765**	**16.000 ± 0.316**	**16.300 ± 1.991**	**15.400 ± 1.279**	**16.600 ± 0.731**	**16.400 ± 1.623**	**12.700 ± 0.903**	**8.200 ± 0.515**

Damage symptoms Paddy



Oxya velox

Acrida exaltata

Recommendations:

The technology developed proved effective in managing grasshopper menace in paddy growing areas of Jammu region.

Benefits/Impacts:

The module developed suppressed the pest populations to economically non threatening levels. Sustainable strategies to minimize the likelihood and extent of grasshopper outbreaks while limiting the need for chemical intervention are a rational and attainable goal for managing grasslands as renewable resources.

Technology 2

Integrated Pest Management of Vegetable crops

Methodology

Survey and surveillance were conducted to identify the extensively growing vegetable areas of Jammu region. Observations were recorded for assessing the seasonal incidence and crop losses caused by various economically important insect pests and diseases on selected vegetables at selected locations throughout the year. Various regional specific IPM modules including IPM devices and microbial pesticides were formulated at different crop growth stages to mitigate the losses caused by insect pests and diseases in nursery raising as well as in field conditions on cole crops, tomato and brinjal. Various eco-friendly chemicals and bio-pesticide were also evaluated for managing the pest population on these crops. For promotion of IPM technology on large scale, demonstrations and trainings were imparted in the potential vegetable growing areas of Jammu region.

Table 1: Reduction in pesticide spray and yield enhancement in selected vegetable crops at Jammu region

S. No.	Crops	Pesticides Pressure in Non-IPM field (Spray)	Pesticides reduction in IPM intervened field (Spray)	Yields enhancement in (%)
1	Cole crops	12	5	15
2	Tomato	12	3-4	30
3	Brinjal	25-30	6-8	22-30
4	Okra	10-12	4-5	10-20






Recommendations

Nursery management in vegetable crops

- Raised nursery beds 8 cm above normal ground level helped in growing better seedlings in nursery.
- Soil 3lavour3sati initiated in the month of June for 6-8 weeks in conjugation of well rotten FYM and *Trichoderma* powder (*T. viridae* and *T. harzianum*) helped in growing disease free seedlings in nursery for early sowing.
- Virus free tomato seedlings were raised using Nylon netting.
- Root dip of tomato seedling for 30 minutes in imidacloprid @ 0.3 ml per lit of water helped in avoiding virus transmission.

IPM TECHNOLOGY FOR COLE CROPS

- Hand picking and mechanical destruction of egg masses and caterpillars especially for cabbage butterfly and *Spodoptera litura* was found to be promising

- Release of *Trichogramma chilonis* @ 50,000 adults /ha per release (6 times) at weekly interval in Mid January helped in reducing damage
- Planting border row of mustard and coriander as flowering plants encouraged the *Cotesia glomeratus,* potential parasitoids against cabbage butterfly larva.
- Biopesticide like Neem oil (4 %) and NSKE 4 % as a blanket spray minimized the hatching of caterpillars in cole crops
- Foliar spray of *Bacillus thuringiensis* formulations @ 500 g/ ha along with sticker (0.5 ml/lit of water) or spinosad @ 0.5 ml per lit or cartap hydrochloride @ 1 ml per lit of water of was found promising to control all lepidopteran insect pests in cole crops.

IPM TECHNOLOGY FOR TOMATO

- Broadcasting carbofuron 3G @ 1 kg per kanal at the time of field preparation was found effective in the mitigating the hibernating insect pests.
- With the initiation of flowering (30 days after transplantation) installation of pheromone traps @ 5-7 per ha for early detection and 12-15 per ha was found promising for mass trapping and mating disruption.
- Planting two border row of African marigold provided enough refugia for trapping the adults of *Helicoverpa* for egg laying and also encouraging the larval parasitoid *Camoletes chloridae* for 4lavour4sation.
- Spray *Ha*-NPV 300 to 500 LE/ha (freshly prepared) mixed with robin blue and stickers @ 2-3 times at 10 days interval at evening hours was found promising in reducing the larval infestation
- Spraying of bacterial formulation *Bacillus thuringiensis* @ 500 g /ha along with sticker (0.5 ml/lit of water) gave the satisfactory control for *Helicoverpa* larvae in the field condition.

IPM TECHNOLOGY FOR BRINJAL SHOOT AND FRUIT BORER (BSFB) ON BRINJAL

- Regular clipping of affected twigs and fruits (Once in 10 days) along with the insect helped in reducing the damage
- Broadcast carbofuron 3G @ 1 kg + 1kg dry sand or soil per kanal was found effective for destroying the hibernating insect pests.
- Installation of Wota trap or water trap with leucin lures @ 100 per ha at 10 m spacing trapped the adults moths for mating disruption.
- Use flowering plants in 5-10 per cent of total cropped area for promotion of natural enemy fauna like parasitoids *Trathala 4lavour-orbitalis, Gonizus* sp. And pradators such as spined pentatomid bug, rediviid bugs and spiders.
- Spraying the crops alternatively with profenophos 50 EC @ 2ml /litre of water at 15 days interval and cartap hydrochloride (1ml/litre of water) starting from 30 days after transplantion was found effective in reducing the brinjal shoot and fruit borer (BSFB) damage.

IPM TECHNOLOGY FOR OKRA (Sucking insect pests)

- Avoid the excessive use of fertilizer doses as it leads to more insect infestation.

- Seed treatment of okra with imidacloprid (Gaucho 600 FS) @ 7 ml (g) / kg seed provided the protection against sucking pests up to 60 days and also checked the transmission of yellow vein mosaic virus by vectors.
- Two to three spray of botanicals like NSKE 5 % solution at 15 days interval gave good control against the pest population.
- Installation of Delta traps or yellow sticky traps to trap the aphids, whitefly etc.
- Planting border rows of flowering plants like saunf or coriander or asters encouraged the natural enemy like *Coccinella* (lady-bird beetles), spiders, wasp, green lacewing, rove beetle and syrphid fly, robber fly and other hymenopteran parasitoids for reducing the insect pest population.
- Spraying of imidacloprid @ 0.3 ml or thiomethoxam @ 0.3 ml per lit of water was found promising in case of severe infestation of sucking pests

(BORER INSECT-PEST COMPLEX ON OKRA)

- Regular clipping off borer infested shoots and fruits helped in reducing the damage.
- Installation of pheromone traps/wota traps @ 100 per ha was found effective in controlling the fruit borer adult moths in okra field.
- Spray NSKE 5 % solution @ 3 ml per lit of water followed by cypermethrin @ 1 ml per lit of water or flubendiamide @ 0.3 ml per lit of water was found effective.

Benefit/Impact

Impact Analysis was conducted on the basis of Questionnaires developed and filled by the farmers before and after the IPM trainings. More than 300 Questionnaires were collected from farmers as the feedback of the IPM technology. The benefits of the IPM technology are as follows-

- More than 3000 pheromone traps, water traps and delta traps have been distributed among the farmers covering over 250 ha of areas under tomato, brinjal, okra and cole crops in Jammu region during 2007-2013.
- More than 15 big trainings and demonstrations were organized to train more than thousands (1035) of farmers as human resource for adoption of IPM technology for growing safer and healthier vegetable crops.
- IPM modules have resulted in 20-30 per cent increase in yield. The pesticides sprays have come down from twelve to three (need based) in case of tomato.
- Pesticidal treatments have also drastically reduced to 6-8 from 25-30 in brinjal crop.
- Farmers are advised to use various types of pheromone traps, microbial pesticides, eco-friendly pesticides and IPM modules for increased productivity of vegetable crops and reduction in use of pesticides.
- Two unemployed graduates were employed as Human resource development during the tenure of projects.

Technology 3

Artificial domiciliation of non–*Apis* pollinators

Methodology

Nesting hut has been prepared for housing shelters of solitary bees. Different nesting material viz., bamboo stems and castor stems of varying size have been prepared for installation for domestication and rearing of non *Apis* pollinator. Castor leaf stalks or stems having tunnel diameters, ranging from 2–11 mm and 10, 15 and 20 cm in length with one end closed were tied into bundles of 10 each and were hung at a location close to the crop area.

Results

Table 1. Acceptance of artificial nesting materials by megachilid bees

Year of study	Period of nesting	Material provided	Number provided	M. haryanaensis	M. flavipes	C. cephalotes	Total
2013-14	Oct-Nov.	Castor (ID 4-8mm)	110	8	0	0	8
	March-April	-do-	200	15	40	24	79
	April-May	-do-	800	76	40	16	132
	July-	-do-	-	87	-	18	105

	August						
2014-15	April	-do-	968	314	56	53	423
	April	Straw (ID 6mm)	700	539	57	15	611

Table 2. Percentage acceptability of different kinds of nesting materials and the rate of cell construction by *Megachile* sp.

Material provided	**No. of nests provided**	**No. of nests accepted**	**Rate of acceptance**				**Avg.cells/nest**	**Cell length/nest**	**Nest closing (mm)**
			April	May	May	June			
Castor (ID 5-7mm)	768	252	4.9	18.5	28.5	32.8	5.5	9.9	6.1
Castor (ID 6 mm)	700	539	14.1	37.5	58.7	77.0	6.1	9.0	6.2

Recommendations: The technology developed for domiciliation of Non-*Apis* pollinators is being utilized for pollination in berseem.

Benefits/Impacts: The technology will enhance crop pollination thereby resulting in increased crop productivity.

Technology 4

Management of *Varroa destructor* Anderson

Methodology

IPM module for management of *Varroa destructor* was developed and tested in different seasons depending upon the brood reaing condition of the colonies. Three applications of each treatment were given in the beginning of each trimester of treatment modules. Pre-treatment count of mites was taken before each application. Thereafter, observations were made after 7, 14 and 21 days after treatment (DAT). For this purpose, 100 cells containing brood were examined for presence of mites.

Results

The efficacy of treatments during different seasons was in the order:

February-April	Queen caging + Cinnamon oil
May-July	Sulphur + oxalic acid
August-October	Formic acid + Cinnamon oil
November-January	Thymol + Oxalic acid



Recommendations : The technology is recommended for managing mites in bee colonies

Benefit/Impact

The *V. destructor* cause severe losses in J&K Punjab, Himachal Pradesh, Haryana and Rajasthan which could also be due to this species. More than 7500 colonies of *A. mellifera* from different apiaries have been sampled for the presence of associated pathogens, mites etc.. Survey reports have revealed a loss of more than 60 to 100 per cent in some apiaries. The losses in terms of fruit and field crops, from honey, beeswax is un - estimated. The technology developed proved to be a game changer in managing *V. destructor.* The number of bee colonies since then has been increased and at present more than 50,000 bee colonies are there in J&K.

Technology 5

Biological suppression of Anar butterfly

Methodology

Anardana is a source of lucrative income for farmers of Udhampur, Doda and Rajouri districts. But Farmers do not get premium price for their produce due to rising infestation by Anar Butterfly, *Deudorix epijarbas* in recent years which reduces its quality and quantity. Its larvae damage pomegranate fruit by boring and feeding on the aril of the seed. The conventional management of this pest is not feasible as, it is a no man's crop and grows wild. Further, the resource poor farmers can not afford the cost of protection. Besides, spraying can not be done in eco-fragile hilly terrains So, it is imperative for the researchers to divert their attention towards sustainable management of this pest on scientific lines and making the commodity more remunerative. Therefore, the biological suppression of this pest through community approach was planned under the aegis of Horticulture Technology Mission programme of Indian Council of Agricultural Research (ICAR).



Recommendations : The technology is recommended for managing fruit borer problem in anardana growing wild in hilly areas of Jammu region

Benefits /Impact

The failure was attributed to presence of ants and excessive rains .the former eat the parasitized eggs on the trichocards and the later lead to their dislodging by washing. Hence, the method of release was refined wherein egg cards are placed inside the thermocol cups for protection from weather and ants and tied to the trees upside down by small string impregnated with vaseline to keep off the ants. Interestingly, there was dramatic decline in fruit damage by this method.

Technology 6

Management of *Helicoverpa* borer in Marigold

Methodology

Fields trials were conducted to evaluate ten different insecticides including control for the management of pod borer. The experiments were carried out at Research Farm, Chatha, SKUAST-Jammu. The land preparation, seedling rate, fertilizer doses, irrigation and other cultural operations were performed as per package of practices of SKUAST-Jammu.

Table 1: Efficacy of different insecticides against pod borer on marigold

Treatments	Concentration/ Dose	Mean *Helicoverpa* population/plant								Yield over control q/ha
		1st spray				2nd spray				
		1DBS	1DAS	7DAS	14DAS	1DBS	1DAS	7DAS	14DAS	
Novaluron 10 EC	**0.100**	12.01 (3.58)	5.46 (2.54)	2.47 (1.86)	0.83 (1.33)	10.83 (3.38)	3.97 (2.17)	2.66 (1.87)	0.60 (1.28)	257.75
Carbosulfan 250 EC	**0.003**	12.33 (3.63)	4.01 (2.22)	1.61 (1.62)	0.52 (1.21)	10.83 (3.41)	3.44 (2.08)	1.60 (1.61)	0.29 (1.12)	263.80
Bifenthrin 10 EC	**0.002**	11.33 (3.46)	5.66 (2.55)	3.49 (2.08)	1.89 (1.67)	10.67 (3.39)	4.33 (2.30)	3.34 (2.05)	1.33 (1.52)	244.13
Neem oil	**0.050**	13.16 (3.76)	11.62 (3.53)	10.50 (3.39)	7.74 (2.97)	11.24 (3.48)	10.66 (3.41)	7.91 (2.51)	6.32 (2.79)	227.09
Control	-	14.00 (3.86)	13.17 (3.75)	12.04 (3.59)	11.04 (3.47)	11.66 (3.55)	11.19 (3.49)	10.09 (3.33)	9.66 (3.26)	215.78
CD (p ≤ 0.05)	-	**NS**	**0.432**	**0.461**	**0.547**	**NS**	**0.484**	**0.666**	**0.395**	
SE(m)		**0.151**	**0.144**	**0.154**	**0.182**	**0.196**	**0.162**	**0.223**	**0.132**	

***DBS – Days Before Spray, *DAS – Days After Spray**

Figures in parenthesis are square √x+0.5 transformed values


Recommendations:

The technology developed proved effective in managing pod borer menace in marigold grown in Jammu region using carbosulfan followed by novaluron and bifenthrin.

Benefits/Impacts:

The farmers in this area are having more than ten years of experience in marigold cultivation and in early days they faced major problem of borers resulting in drastic reduction of flower yield. Because of their lack of knowledge and awareness about modern management practices and inefficient and indiscriminate use of inputs they have faced the problem of reduction in productivity of marigold The recommendation for the *Helicoverpa* management had a major pragmatic impact resulting in contributing to 33-45% higher net profits for smallholder farmers, 25-30% higher yields in IPM plots.

Technology 7

Management of Wheat Aphid

Methodology

Fields trials on wheat variety PBW-550 was conducted in the randomized block design to evaluate ten different insecticides including control for the management of wheat aphid. The experiments were carried out at Research Farm, Chatha, SKUAST-Jammu. The land preparation, seedling rate, fertilizer doses, irrigation and other cultural operations were performed as per package of practices of SKUAST-Jammu.

Table . Efficacy of different insecticides against wheat aphid

Treatments	Concentration	Average yield (q/ha)	Increase in yield over control	Value of additional yield (Rs)	Cost of treatment (Rs)	Net profit (Rs)	Cost benefit ratio
Imidacloprid 200SL	0.009%	32.65	11.40	25650.00	1150	24500.00	1:21.30
Thiamethoxam 25WG	0.045%	31.72	10.47	23557.50	1980	21557.50	1:10.89
Dimethoate 30 EC	1.5%	30.59	9.34	21015.00	815	20200.00	1:24.78
Acetamiprid 20 SP	0.1%	24.87	3.68	8280.00	550	7730.00	1:14.05

Oxy demton methyl 25EC	1.5%	28.48	7.23	16267.50	650	15617.50	1:24.02
Control	-	21.25	-	-	-	-	-

Recommendations:

The technology developed proved effective in managing wheat aphid menace using imidacloprid followed by Thiamethoxam. The strategy of using imidacloprid gave satisfactory and reliable control of wheat aphids resulting in 34.02% increase in yield having a Cost : Benefit ratio of 1:21.30 over control.

Technology 8

Management of leaf folder in paddy

Methodology

Fields trials were conducted to evaluate ten different insecticides including control for the management of pod borer. The experiments were carried out at farmer's field. The land preparation, seedling rate, fertilizer doses, irrigation and other cultural operations were performed as per package of practices of SKUAST-Jammu.

Table : Economics of IPM against leaf folder

Treatments	Concentration	Average yield(q/ha)	Increase in yield over control	Value of additional yield (Rs)	Cost of treatment (Rs)	Net profit (Rs)	Cost benefit ratio
Clothianidin	0.06%	62.75	24.48	14,688	1150	13,535	1:11.77
Betacyfluthrim +Chlorpyriphos	0.04%	64.25	25.98	15,588	1750	14,838	1:8.48
Bacillus thuringiensis	500gm a.i /ha	54.65	16.38	9,828	1400	8,428	1:6.023
NSKE	5%	49.25	10.98	6,588	500	6,088	1:12.18
Rope method	-	46.25	7.98	4,788	400	4,388	1:10.97
Rope method +Bt	-	56.75	18.48	11,088	1800	9,288	1:5.16
Rope method + NSKE	-	53.25	14.98	8,988	900	8,088	1:8.99
Control	-	38.27	-	-	-	-	-

Recommendations:

The technology developed proved effective in managing leaf folder menace in rice. Betacyfluthrin + chlorpyriphos followed by Clothianidin were found to be best treatment against leaf folder control. Therefore, the Betacyfluthrin + chlorpyriphos as conventional spray applications, followed by Clothianidin, are may be recommended for the control of leaf folder in paddy.

Benefits/Impacts:

The insecticides used suppressed the pest population to economically non threatening levels.

Technology 9

IPM modules against Aonla fruit borer

In view of severity of damage caused by fruit borer on aonla,different IPM modules against fruit borer were evaluated to ascertain the effective control measures in a field trail on NA-7 aonla variety in the randomized block design. For each module, observations were recorded by counting the total number of infested and healthy fruits at 15 days interval. The data thus obtained was converted into per cent fruit damage. *In toto*, there were three different types of modules besides control, each replicated four times.

Table: Evaluation of different modules on the infestation of fruit borer on aonla.

Modules	**Total no. of fruits studied**	**No. of infested fruits**	**Weight of healthy fruits (g)**	**Weight of infested fruits (g)**	**% infested fruits (by number)**	**% infested fruits (by weight)**	**% infestation reduction over control (by number)**
Module-I (Soil raking, Neem cake @ 25 kg /ha, *Bacillus thuringiensis* (500 gm/ha) followed by spinosad 45 SC (150-200 ml/ha) application**)**	40	14.25 (3.904)	695 (26.378)	407.5 (20.209)	39.25 (6.342)	25.5 (5.127)	32.91
Module-II (Soil raking, Carbofuran 3G @ 25 kg per ha, Imidacloprid 17.5 SL (0.003%) followed by cartap hydrochloride 50 SP @ 0.05 % sparying**)**	40	4.75 (2.334)	922.5 (30.386)	79.5 (8.955)	10.5 (3.348)	11.5 (3.516)	82.05
Module-III (Soil raking and spray of dimethoate 30 EC (0.05%) followed by fenvalerate (0.07%) 20 EC as recommended by CIAH, Bikaner.**)**	40	10.5 (3.387)	750 (27.403)	200.5 (14.191)	28.25 (5.407)	33 (5.825)	51.71
Untreated control	40	25.25 (5.120)	517.5 (22.769)	700 (26.475)	58.5 (7.709)	41 (6.476)	-
SE(m)±		0.162	0.213	0.230	0.190	0.219	
CD at 5%		0.526	0.689	0.747	0.617	0.711	
CV (%)		8.804	1.590	2.636	6.671	8.366	

Recommendations:

The module-II which comprises soil raking, carbofuran 3G @ 25 kg per ha, imidacloprid 17.5 SL (0.003%) followed by cartap hydrochloride 50 SP @ 0.05 % spraying found promising in reducing the damage potential of fruit borer on aonla. The best treatment soil raking, carbofuran 3G @ 25 kg per ha, imidacloprid 17.5 SL (0.003%) followed by cartap hydrochloride 50 SP @ 0.05 % spraying recorded 115kg/Tree or 54.65% higher fruit yield increase over control treatment of water spray.

Benefits/Impacts:

The insecticides used suppressed the pest population to economically non threatening levels. The higher yield resulted in higher benefit cost ratio to the farmers.

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