J. Biol. Control, 10:53-59, 1996

A new field application technology for *Chrysoperla* larvae

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ABSTRACT : A *Chrysoperla* larval applicator named as Durgapura *Chrysoperla* larval applicator (DCLA) has been designed, developed and tested for application against soft bodied insect pests in crops. The applicator is cheap, and can be easily fabricated from locally available materials by village artisans. The applicator has a boom (hollow aluminium rod), on which plastic containers are screwed, as per the row spacing of the crops. The entire applicator hangs on the shoulders of the operator. The containers are filled with desired number of *Chrysoperla* larvae in an inert carrier. During application, the operator walks between the crop rows and keeps on striking the boom with two light wooden rods to facilitate uniform release of the predatory larvae on to the crop. The larvae so released, are either trapped on whorl or leaves and those falling on soil search their way to the prey. The field tests on barley, cotton, cowpea and chilli crops revealed that the applicator performance efficiency ranged from 69.23 to 73.64 per cent, and the output from 2.59 to 3.07 h for one hectare crop area.

KEY WORDS : Biological control, *Chrysoperla carnea*, *Chrysoperla* larval applicator

The larvae of *Chrysoperla* spp. (Neuroptera : Chrysopidae) are potential predators of soft bodied insect pests and have long been recognised as an effective tool for their management (Canard *et al.*, 1984). This predator is now mass multiplied at many commercial and research centres for augmentation in field as a component of IPM programmes. However, the release of the larvae on individual plant / plant canopy with saw dust through perforated containers or cones or dropping it from the corrugated paper strips in the field is a cumbersome and time consuming process.

Keeping this in view, a new field application technology for *Chrysoperla* larvae has been designed, developed and perfected at this centre. The applicator is called as Durgapura *Chrysoperla* larval applicator (DCLA).

MATERIALS AND METHODS

Design and fabrication of applicator

The iron, aluminium rods, plastic containers, steel screws, nylon strips and buffer strips purchased from the local market were utilised to fabricate the applicator.

1. Boom : It was made from a hollow aluminium rod, 152 cm in length and 1.5 cm in diameter. Regular holes at 5 cm interval were punched all along the rod leaving 1 cm at both ends. The lids (6 cm diam) of plastic containers (250 ml capacity) were fastened with 1 cm steel screw to the rod by making holes in the centre of the lid. A steel plate washer (1 cm diam) was used on the lower surface to strengthen the plastic lid. The attached plastic container had a central hole of 4 mm at the bottom.

2. Brace Plate : A 35 x 2 cm iron brace plate was fastened with the screws between the waist plate and the boom to keep it in perfect horizontal position and also to prevent falling of larvae on the feet of operator during application.

3. Waist Plate : A semi-circular arch shaped iron plate, 4 cm wide and 18 cm radius was attached to the brace plate to fit on the tummy of the operator. The upper and lower margins of the plate were bent on opposite side to prevent sharp plate margins piercing into the skin of the tummy. Both ends of the arch were provided with hooks for fixing and fastening the waist belt.

4. Waist belt : A 3 cm wide waist belt was attached to the left side hook of the waist plate. The other end was kept free for tightening by locking the strip through the hook on the right end of the waist plate.

5. Cross belt : Two nylon cross belts, 3 cm wide, were fixed on the boom with a screw, 25 cm away from both the ends of the boom. The other side of each belt was attached to the hooks of the waist plate. Buckles were provided to adjust the length of the belt according to the height of the operator and the crops.

6. Striking rods : Two striking rods of 1.5 cm diameter and 45 cm length, weighing 50 g each, were designed to strike the boom by the operator and the striking force was estimated to range from 0.25 - 0.30 newton on the boom.

Operation of applicator

The carrier material mixed with required number of larvae was filled in plastic containers and screwed to the lids attached to the boom. The applicator was hung on the shoulders of the operator and the operator made to walk between the crop rows, and gently striking the boom

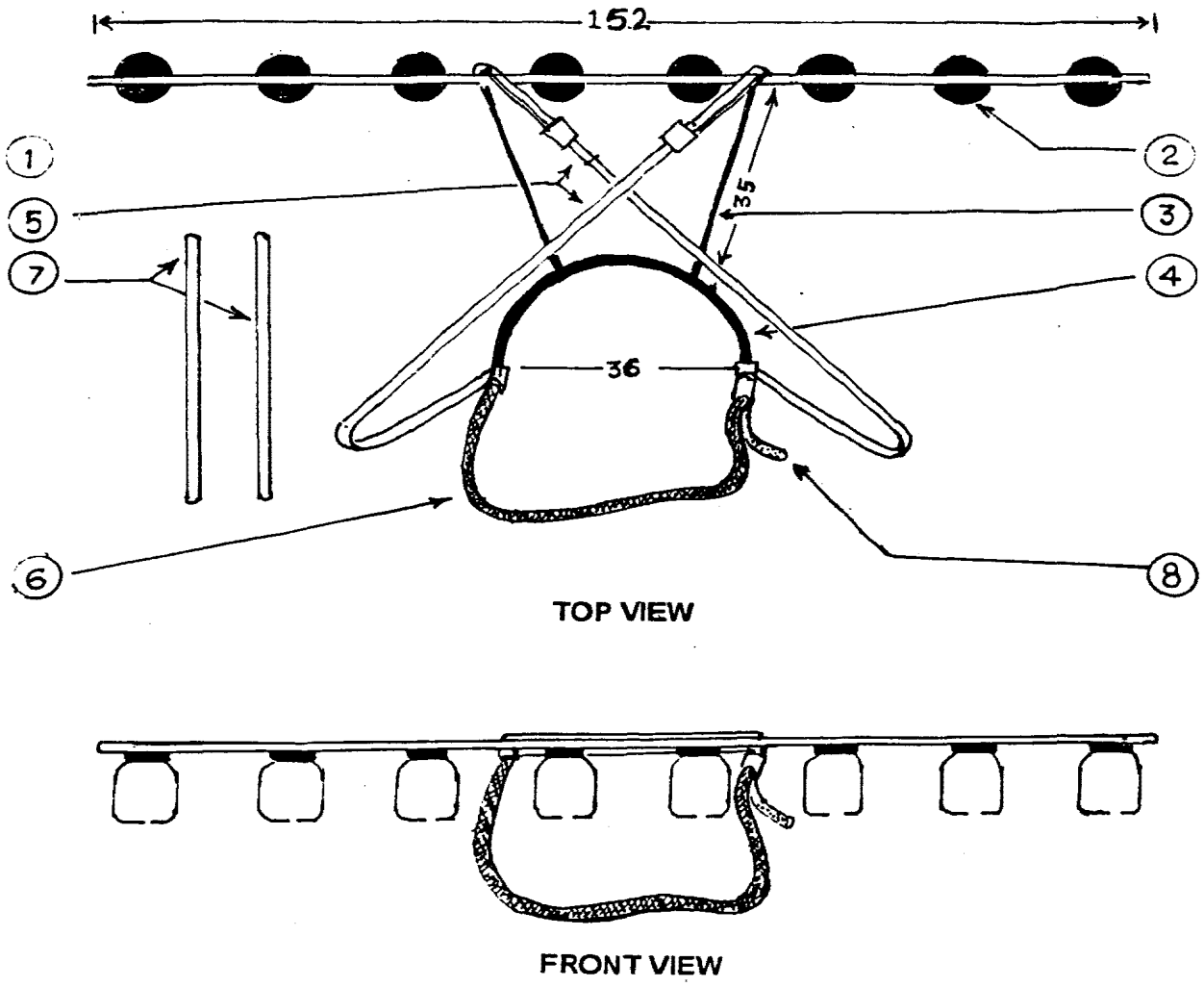

Fig.1. Durgapura *Chrysoperla* larva applicator

All dimension in cm

No. name of the parts

1. Main Rod (boom)	2. Plastic containers	3. Brace plate	4. Waist plate
5. Cross belt	6. Waist belt	7. Striking rods	8.Locking strap

regularly with the help of striking rods, thereby shaking the containers uniformly and constantly. This would enable the carrier material along with *Chrysoperla* larva present to be discharged evenly through the bottom holes of the containers.

Chrysoperla larval culture

Chrysoperla carnea (Stephens) larvae were obtained from the stock culture being maintained at the Biocontrol Laboratory of Agricultural Research Station, Durgapura, Jaipur.

Inert carriers

Of the three inert carriers used; the cow dung and goat pellets were collected from animal shed, and saw dust from saw mills. All the inert materials were sun dried for 5 - 6 days. The dried cow dung and goat pellets were stone ground and graded in two particle sizes, below 1 mm and 1 - 2 mm. The saw dust was also similarly graded into two particle sizes.

Safety of inert material for *C. carnea* larvae

Cow dung, goat pellets and saw dust of two different particle sizes, i.e. below 1 and 1 - 2 mm were kept separately in six plastic containers of 250 ml capacity. Hundred larvae of about 48 h old were mixed with the inert material and manually shaken constantly for half an hour. Thereafter, the larvae present in carrier material were removed and maintained on *Corcyra cephalonica* eggs. The dead or moribund larvae obtained at the time of removal were recorded. The cumulative mortality up to a period of 3 days was also recorded in each treatment. Each treatment was replicated 4 times.

Inert carrier release rate

All the containers of the applicator were filled with different grades of inert materials. The time required for emptying the containers and the area covered were recorded in four different crops, *viz.* cowpea, cotton, barley and chilli.

Assessment of the performance index of the applicator

(a) Field efficiency

The average value of performance of the applicator (nf) was recorded in four different crops using the following formula:

$$n = \frac{T \times 100}{T_a}$$

where T = Theoretical time required to cover an area of 1 ha, which was calculated by the speed of the operator to cover 1 ha without any time loss

t_1 = Time loss during turning

t_2 = Time loss in going to filling station for recharging the containers

t_3 = Time loss during break down

T_a = Actual time required to cover an area of 1 ha ($T + t_1 + t_2 + t_3$)

(b) Output of the applicator

This refers to actual area covered by the application in ha and is expressed by the following formula:

$$O_a = \frac{W \times S \times nf}{1000}$$

where S = Speed of the operator in km/h

W = Width of the applicator + distance between the rows in metres

nf = Field efficiency in per cent

RESULTS AND DISCUSSION

The results of laboratory and field tests on the various measurements for the performance of the DCLA are presented in Tables 1 and 2.

Safety of inert carrier against *C. carnea* larvae

The laboratory tests indicated that all the three inert materials used as carriers for *C. carnea* larvae were quite safe. However, among the two particle sizes,

Table 1. Bioefficacy of different inert materials vis-a-vis *C. carnea* larvae

Test material	Particle sizes	Av. wt. of the mixture (g)	Container emptying time in the field (sec)	Area covered (m)*	Corrected cumulative per cent mortality (after 3 days)
Saw dust	< 1 mm	60	640	705.80	10.20
Saw dust	1-2 mm	56	905	998.13	2.04
Ground cow dung	< 1 mm	48	650	716.89	6.12
Ground cow dung	1-2 mm	42	915	1020.19	1.02
Ground goat pellets	< 1 mm	58	685	755.50	4.08
Ground goat pellets	1-2 mm	55	942	1038.95	1.02

* Average speed of the operator was 2.647 km/h

maximum corrected cumulative mortality of 4.08, 6.12 and 10.20 per cent was recorded in < 1 mm size goat pellets, cow dung and saw dust, respectively (Table 1). A few dead or moribund larvae, recovered from < 1 mm size grade, were examined under a binocular microscope. In most of the cases haemolymph oozed spots were found on the cuticle, indicating thereby that fine dust particles present caused mechanical injury on soft cuticle of 2-day-old larvae during shaking. Further, a few larvae without such oozed spots probably died of asphyxiation, as the inert material particle space is much less and the constant shaking further reduced the space and packed them. The bigger particle size (1 - 2 mm) rather provided a cushion to the larvae during shaking. The use of saw dust as carrier for *Chrysoperla* larvae is most prevalent, unfortunately saw dust is not available in all the villages. The cow dung and goat pellets tested in the present study are equally effective for larval application. Moreover, it is a better replacement as it is available free of cost in all the villages and its application to the cultivable soil is beneficial.

Operation of the applicator

The weight of the applicator is increased from 640 g to 934 - 1032 g when filled with carrier material mixture. Since the entire weight of the applicator hung on shoulders is about one kg the operation can be carried with ease. The striking rods are quite light (50 g each) and the effort by the operator for striking the boom was considerably less.

The operational test carried out in four different crops, *viz.*, cowpea, cotton, barley and chilli indicated that an untrained labourer can operate the applicator and apply the predator on the crops with ease. The predatory larvae dropped on barley crop were found trapped in adequate numbers in the central whorls or the leaves. The remaining ones which dropped on the soil were found to reach the prey.

Assessment of performance of the applicator

The field efficiency and the output of the DCLA was recorded maximum in cotton and least in barley. This difference may be attributed to row to row distance which was higher in cotton than the barley. The crop canopy in barley is a limiting factor during operation as compared to cotton crop where sufficient space is available to the operator during the walk, between the rows. The field efficiency and the overall performance indices in different crops have been presented in Table 2. It was thus observed that among the four test crops, 2.83 to 3.23 h are required to cover an area of one hectare whereas, by the conventional method, like dropping the larvae from corrugated paper strips (Anon., 1995) required 14 - 16 h. The predator application on the crops is recommended during evening hours when solar radiation is mild and the environmental conditions are rather favourable. To cover an area of one hectare during evenings about 4 to 5 days are required with conventional method. However, with DCLA one hectare area can be covered in just one evening.

Table 2. Field efficiency and the output of the applicator in different crops

Crops	Row to row distance (cm)	Total time	Time loss during application (sec)			Total time loss (sec)	Time to cover one ha (sec)	nf (%)	Output of applicator (ha/h)
			t_1	t_2	t_3				
Cowpea	30	10970	226	3021	0	3247	7723	70.40	3.01
Cotton (Bikaneri Nerma)	60	9440	205	2314	0	2519	6921	73.32	2.59
Barley	25	11195	230	3200	0	3430	7765	69.36	3.07
Chilli	45	9957	228	2397	0	2625	7332	73.64	2.83

Advantages of DCLA

1. The entire instrument is folded and can be dismantled or fitted on demand and as such needs very little space for storage. It can also be carried from one place to another with ease.

2. To overcome the problem of rusting, minimum of iron is used in the fabrication of the applicator. All the parts of it can be fabricated by a village artisan.

3. The material used in fabrication is locally available and can be replaced, if any part is damaged by chance.

4. The applicator may also be used as a duster for entomophagous pathogens and insecticidal granules sprinkler.

ACKNOWLEDGEMENT

The authors are grateful to the Director (Research), Rajasthan Agricultural University, Campus Bikaner for facilities provided and encouragement.

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