Research Article

FRUIT BAGGING WITH CLOTH BAG: AN ECO-FRIENDLY AND COST EFFECTIVE MANAGEMENT METHOD OF CUCURBIT'S FRUITFLY *(Bactocera cucurbiteae* Coq.) ON BITTER GOURD *(Momordica charantia* L.) IN KATHMANDU, NEPAL

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ABSTRACT

An experiment was cunducted during May-July 2018 in Nagarjun-1, Kathmandu, Nepal to evaluate the effectiveness and timing of fruit bagging with cloth bag against cucurbit fruitfly (*Bactocera cucurbiteae* Coq.) on Bitter gourd (*Momordica charantia* L.). Three treatments were used- fruit bagging with cloth bag within a day of anthesis, fruit bagging with cloth bag in 2nd-3rd day of anthesis, and control (unbagged); each treatment with 30 replications. Analysis of variance was done using GenStat and mean comparison by DMRT. Experiment results revealed that the average length, breath, gross weight and the edible weight of the fruit bagged within a day of anthesis were significantly better than the fruit bagged on 2nd-3rd day of anthesis, and control (unbagged) (length: 29.4, 20.25 & 12.78cm; breath: 14.83, 13.65 and 9.07cm; gross fruit weight: 315.4, 207.43 and 113.37g/fruit; and the edible fruit weight: 100%, 73.42% and 10.43% ,respectively). There is an imance need of cost effective, environmentally safe and perfect management practices against cucurbit fruit fly. For this, fruit bagging with cloth bags earliest after the anthesis is recommended.

Key words: Anthesis, environment, safe practice

INTRODUCTION

Cucurbit fruit fly *B. cucurbiteae* Coq. is the most problematic insect pest of the cucurbits which attacks young and older fruits (Plantwise, 2012). Alam (1969) and Butani & Jotwani (1984) also reported that the Cucurbit fruit fly is the significant obstacles for economic production causing considerable damage of cucurbit fruits. It can attack more than 16 different types of Cucurbit crops viz., bottle gourd, bitter gourd, snake gourd, white gourd, ridge gourd, sponge gourd, cucumber, pumpkin, etc. The degree of damage varies by yield and quality on different Cucurbits. Yield losses due to fruit fly infestation on different Cucurbits vary from 19.19 to 69.96% (Kabir et al., 1991) and are the most serious in melon causing damage up to 100 percent (Atwal, 1993; Nasiruddin et al., 2004). Fruit fly damage starts from March and ends in August or September. Female flies lay eggs inside the fruit. The eggs hatch inside the infected fruits, get maggots, fruit get rotten and non-edible (Plantwise, 2012). Numerous maggots may be seen within infected fruits. After 7 to 10 days the maggot will drop into the soil and pupate. The adult fly is pale yellow to brown with transparent wings having 2 spots on each (Plantwise, 2012).

Plantwise (2012) recommended collecting damaged fruits regularly and destroying them in a deep hole or soaking in water mixed with a chemical insecticide. In addition it is recommended using a food bait prepare from the yellow crushed ripened pumpkin applied with the drops of Malathion 50 EC 0.1 % solution over it and keep it in different places on the ground near the crop. Alternative solutions are covering the whole vines with young fruits with newspapers or waste clothes in kitchen garden cultivation to avoid the laying adults or to spray with a mixture of Malathion 50 EC at 1 ml/liter of water and 20 grams of sugar or molasses if more than 10% of fruits are infected and wait for 7 days for harvesting. Soil treatment with Malathion 5 % powder 20 kg per Ropani during winter combined with deep ploughing in winter to damage the pupae is also recommended (Plantwise, 2012). Several authors highly advocated hand picking of infested fruits to reduce fruit fly damage on cucurbit vegetables. Assignment Point (1992) recommended collection and destruction of infested fruits with larvae inside for reducing fruits fly population on snake gourd. Assignment Point (1990) reported that this practice was widely used in USA for suppressing Mediterranean fruit fly *Ceratitis capitata*. Atwal (1993) suggested such mechanical control measures in farmer's fields as normal practice for effective control against this pest in India.

Several authors recommended field sanitation for suppression of fruit fly population in many countries (Agarwal et al., 1987; Assignment Point, 1990; Smith & Brown, 1992). Assignment Point (1992) found the bait traps a potential control measure for fruit fly, *B.* (Dacus) *cucurbitae* Coq., in snake gourd in kharif, 1990 at Comilla Bangladesh. They also found various sex pheromones dispensers and mashed sweet gourd traps effective for Fruit fly capture. Cuelure +methyl eugenol + naled captured significantly more fruit flies (269) in February to April, 2000 in Bangladesh. Rahman et al. (2002) found lower Cucumber and Bitter gourd fruit infestation and higher yield in silver color ribbon used plots followed by yellow, red, indigo color ribbon over control in rabi season at BSMRAU, Gazipur, Bangladesh. Aktaruzzamn et al. (1999) was able to suppress the fruit fly infestation significantly (5.53%)

with bagging Cucumber fruits at 3rd days of anthesis and retained for 5 days resulted higher fruit yield in Bangladesh. Islam et. al., 2018 recommended to adopt IPM technology for the better income from Bitter gourd cultivation. Kapoor (1993) developed and suggested a cluster method to control cucurbit fruit fly. However, it is very difficult to control cucurbit fruit fly due to its biology and nature of infestation. The chemical control is still popular to the farmers because of its quick and visible results but the resurgence and resistance of the pest and the high level of residues in market produce is a serious problem. Thus an environment friendly, cost effective and the practical alternative solution of cucurbit fruit fly management is very crucial. In this connection my wife is practicing fruit bagging with cloth bag against Cucurbit fruit fly in kitchen garden level since few year back. She claimed it is one of the environment friendly, cost effective and the practical alternative solution for Cucurbit fruit fly management for the resource poor farmers in Nepal. This experiment was designed and cunducted to evaluate the effectiveness and timing of fruit bagging with cloth bag against cucurbit fruitfly *B. cucurbiteae* Coq. on Bitter gourd in summer to rainy season of 2018.

MATERIAL AND METHODS

The experiment was cunducted in Kathmandu valley in summer to rainy season in 2018 on Bitter gourd. The varieties adopted was White long. Ten seedlings were collected from Nucleous Vegetable Seed Production Centre Khumaltar. One month old seedlings were planted at 2x1m distance in March 11, 2018. Vermi compost at the rate of 3kg/plant was used at planting time in each planting pit. Special bamboo thatch was prepared before planting, for staking. Irrigation and weeding was carried out as per necessary. Non of the chemicals were used for manuring and plant protection. Actual observation of the experiment was taken after the use of the cloth bags in May Ist week when the vine were full grown and on fruiting stage (Figure 1).

Figure 1. Application of cloth bags on Bitter gourd fruits on the bamboo thatch, Nagarjun-1, Kathmandu, 2018

Old and used house hold bedsheets, blanket covers, shirts and pants that were free of cost, were collected. The damaged portions were cut out with a scissors. Pieces of clothes from old bedsheets and blanket covers, of 24×35cm size were prepared. The longitunal margins were folded to each other and stiched with a sewing machine to have 12cm of the bag width. One of the end was also stiched to prepare the cloth bags opening at the top. Half way 2 cm wide cross section from the top has been cut to prepare the tying strings while bagging the fruits (Figure 2). The legs and hand parts from the old paints and shirts were also taken for the similar use.

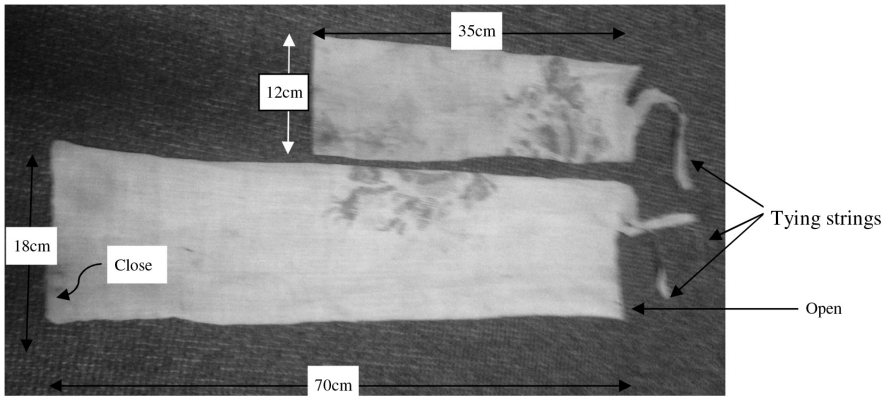

Figure 2. Cloth bags prepared from the old and used clo thes for fruit bagging against fruit fly, 2018

Three different treatments were adopted: fruit bagging with cloth bag within a day of anthesis, fruit bagging with cloth bag on 2nd or 3rd days of anthesis, and control (with out bagging but ribbon tagged). Anthesis was noticed with the immidate wilting of the corolla from the female flower. Three replications were considered in each day per week and was repeated for 10 weeks (total 30 replications). Each bags were removed after 10 days in case of the fruit bagged 1st day of anthesis and after 7 days in case of the fruits bagged 2nd-3rd day of anthesis (all bags in 10 days of anthesis). The Length, breath, gross weight and the edible weight of the harvested fruit from each treatment were recorded. Collected deta were tabulated. Analysis of variance (ANOVA) was done by using the software GenStat, and mean comparison was done by DMRT.

RESULTS AND DISCUSSION

Effect of fruit bagging with cloth bag on Bitter gourd production

The length, breath, weight and edible weight of Bitter gourd fruit was significantly higher with the fruits cloth bagged with in a day of anthesis compare to fruit bagged on 2nd-3rd day of anthesis and Control (unbagged) (Figure 3). The average length of the fruit bagged with in a day of anthesis was 29.4cm, where, it was only 20.25cm in case of the fruit bagged on 2nd-3rd day of anthesis and only 12.78cm on unbagged. Similarly the average breath of the fruit bagged with in a day of anthesis was 14.83cm compare to 13.65cm of the fruits bagged on 2nd-3rd day of anthesis and only 9.07cm on unbagged. Likewise, the average gross weight of the fruit bagged with in a day of anthesis was 315.4g compare to 207.43g of fruit bagged on 2nd-3rd day of anthesis, and 113.37g of unbagged. The fruit bagged with in a day of anthesis were 100% edible, where, only 73.42% of the fruit weight bagged on 2nd-3rd day of anthesis and only 10.43% from unbagged were edible (Figure 3, Table 1).

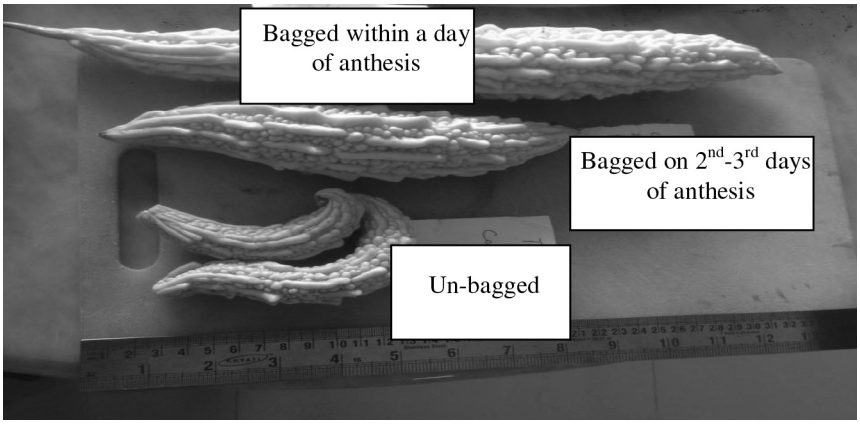

Figure 3. Effect of fruit bagging with cloth bag on Bitter gourd fruit length, breath and weight, Kathmandu, 2018

Table 1. Descriptive statistics of different variables on Bitter gourd fruit produced from dfferent treatments, Nagarjun-1, Kathmandu, 2018

Variables	Treatments	Mean (Std)	Range
Length (cm)	Fruit bagged with in a day of anthesis	29.4 (2.9)	23.0-33.0
	Fruit bagged on 2nd-3rd day of anthesis	20.3 (3.4)	16.0-30.0
	Un-bagged	12.8 (2.0)	10.0-18.0
	Total	**20.8 (7.4)**	**10.0-33.0**
Breath (cm)	Fruit bagged with in a day of anthesis	14.8 (1.5)	12.0-17.0
	Fruit bagged on 2nd-3rd day of anthesis	13.7 (1.2)	11.0-16.0
	Un-bagged	9.1 (1.2)	7.5-12.0
	Total	**12.5 (2.8)**	**7.5-17.0**
Weight (g)	Fruit bagged with in a day of anthesis	315.4 (45.5)	235.0-380.0
	Fruit bagged on 2nd-3rd day of anthesis	207.4 (53.8)	135.0-350.0
	Un-bagged	113.4 (26.6)	62.0-160.0
	Total	**212.1 (93.5)**	**62.0-380.0**
Edible weight (g)	Fruit bagged with in a day of anthesis	315.4 (45.5)	235.0-380.0
	Fruit bagged on 2nd-3rd day of anthesis	152.3 (71.7)	50.0-310.0
	Un-bagged	11.8 (27.2)	0.0-115.0
	Total	**159.8 (134.7)**	**0.0-380.0**

Note: Replication=30

Effect of fruit bagging with cloth bags on length of Bitter gourd fruit

The harvested fruit of Bitter gourd, cloth bagged with in a day of anthesis were significantly longer than the fruit bagged on second-third day of anthesis and unbagged. The average length of the fruit bagged with in a day of anthesis was 29.4cm compare to 20.5cm of the fruit bagged on 2nd-3rd day of anthesis and 12.78cm of unbagged. The average fruit length was also differed by the age of the plant with a change in season. The length of the fruit bagged with in a day of anthesis were 31.11cm in May, 25.33cm in June, and 25.33cm in July 2018. Where, it was 20.89cm, 21.1cm, 17. 17cm for the fruit bagged on 2nd-3rd day of anthesis, and 14.56cm, 12.47cm and 10.92cm for unbagged in May, June and July, respectively (Table 2, Figure 4).

Table 2. Effect of treatments on length of bitter gourd fruit, Nagarjun-1, Kathmandu, 2018

Treatments	Length (cm)
Fruit bagged within a day of anthesis	29.40c
Fruit bagged on 2nd-3rd day of anthesis	20.25b
Control (non bagged)	12.78a
CV	13.8
LSD	1.475
Grand mean	20.81

Note: Means followed by the same small letters in a column are not significantly different by DMRT (≤0.05 level).

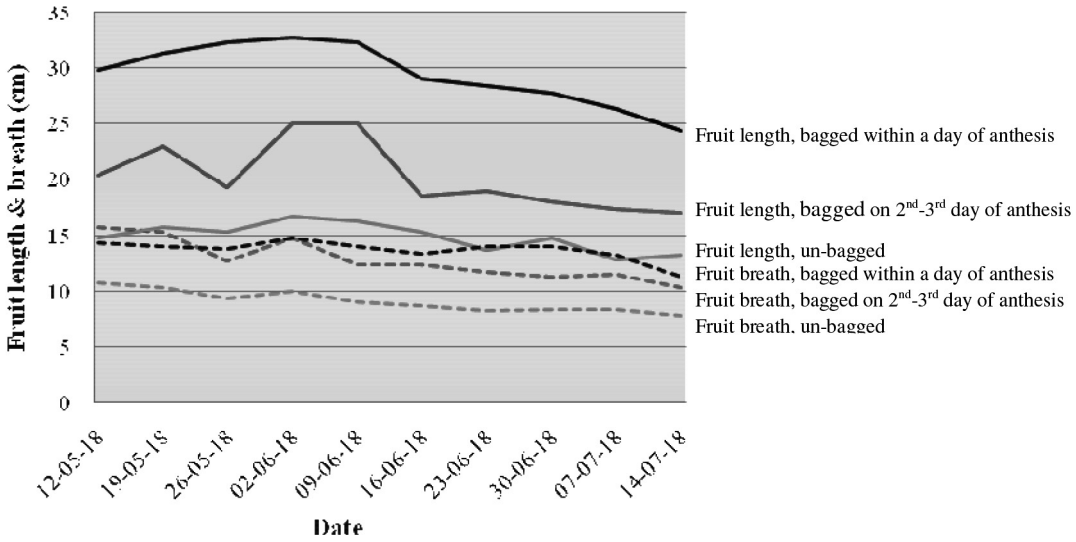

Figure 4. Effect of fruit bagging with cloth bag on size of Bitter gourd fruits, Nagarjun-1, Kathmandu, 2018.

The average length of the fruit were 31.12% shorter in case of the fruit bagged on 2nd-3rd day of anthesis and 56.53% shorter for unbagged compare the fruit bagged with in a day of anthesis. The shortness of the fruit were increasing over the months. The average length of the fruit bagged on 2nd-3rd day of anthesis and unbagged were shorter by 32.85%, 29.67%, 17.17% and 53.20%, 58.43% 56.89% in May, June and July, respectively. Reduction of fruit length over the months was mainly because of the heavy rain and the population pressure of fruitfly as well (Table 2, Figure 4).

Effect of fruits bagging with cloth bags on breath of Bitter gourd fruit

The harvested fruit of Bitter gourd cloth bagged with in a day of anthesis were significantly thicker than the fruit bagged on second-third day of anthesis and unbagged. The average breath of the fruit bagged with in a day of anthesis was 14.83cm compare to 13.65cm of the fruit bagged on 2nd-3rd day of anthesis and 9.07cm of unbagged. The average breath of the fruit bagged within a day of anthesis were 15.22cm in May, 15.33cm in June, and 13.00cm in July 2018. Where, it was 14.00cm, 14.00cm, 12.25cm for the fruit bagged on 2nd-3rd day of anthesis, and 10.11cm, 8.83cm and 8.08cm for un-bagged in May, June and July, respectively (Table 3, Figure 4).

Table 3. Effect of treatments on breath of bitter gourd fruits, Nagarjun-1, Kathmandu, 2018

Treatments	Breadth (cm)
Fruit bagged within a day of anthesis	14.83c
Fruit bagged on 2nd-3rd day of anthesis	13.65b
Control (non bagged)	9.07a
CV	10.8
LSD	0.691
Grand mean	12.2

Note: Means followed by the same small letters in a column are not significantly different by DMRT (≤0.05 level).

The average breath of the fruit were 7.96% shorter in case of the fruit bagged on 2nd-3rd day of anthesis, and 38.86% shorter for un-bagged fruit compare with the fruit bagged with in a day of anthesis. The shortness of the fruit were increasing over the months. The average breath of the fruit bagged on 2nd-3rd day of anthesis and un-bagged were shorter by 8.02%, 8.68%, 5.77% , and 33.57%, 42.40% 37.85% in May, June, and July, respectively. Reduction of fruit breath over the months is mainly because of the heavy rain in mansoon and the population pressure of fruitfly as well (Table 3, Figure 4).

Effect of fruit bagging with cloth bags on gross fruit weight of Bitter gourd

The gross weight of the harvested fruits of Bitter gourd cloth bagged with in a day of anthesis were significantly higher than the fruit bagged on second-third day of anthesis and unbagged. The average gross fruit weight of the fruits bagged with in a day of anthesis was 315.40g/fruit compare to 207.43g/fruit of the fruit bagged on 2nd-3rd day of anthesis and 113.37g/fruit of unbagged. The average gross fruit weight of the fruit bagged with in a day of anthesis were 338.89g/fruit in May, 325.13g/fruit in June and 255.83g/fruit in July 2018. Where, it was 226.11g/fruit, 218.2g/fruit, 152.5g/fruit in case of the fruit bagged on 2nd-3rd day of anthesis, and 130.78g/fruit, 109.6g/fruit, 96.67g/fruit of unbagged in May, June and July, respectively (Table 4, Figure 5).

Table 4. Effect of treatments on gross weight of bitter gourd fruits, Nagarjun-1, Kathmandu, 2018

Treatments	Gross weight (gm)
Fruit bagged within a day of anthesis	315.40c
Fruit bagged on 2nd-3rd day of anthesis	207.40b
Control (non bagged)	113.40a
CV	20.7
LSD	22.53
Grand mean	212.1

Note: Means followed by the same small letters in a column are not significantly different by DMRT (≤0.05 level).

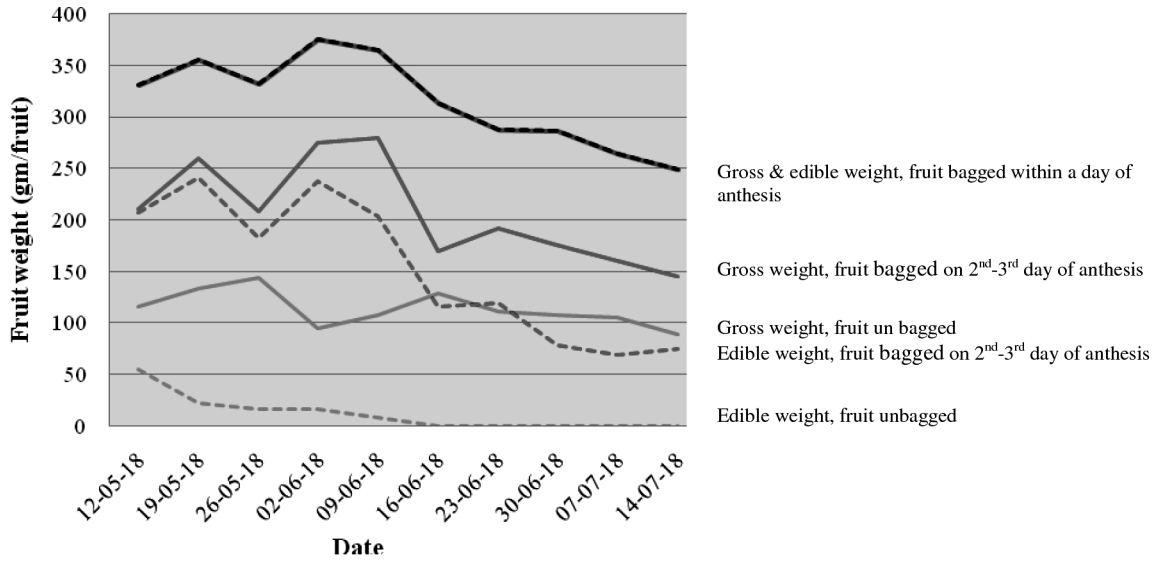

Figure 5. Effect of fruit bagging with cloth bag on gross weight of Bitter gourd fruit, Nagarjun, Kathmandu, 2018

The average gross weight of the fruit were 33.28% lower in case of the fruit bagged on 2nd-3rd day of anthesis and 61.41% lower for unbagged compare to the fruits bagged with in a day of anthesis. The lowerness of gross fruit weight were increasing over the months. The average gross weight of the fruits bagged on 2nd-3rd day of anthesis and unbagged were lower by 33.28%, 32.89%, 40.39% and 61.41%, 66.29%, 62.21% in May, June and July, respectively. Reduction of gross fruit weight over the months was mainly because of the heavy rain in mansoon and the population pressure of fruitfly as well (Table 4, Figure 5).

Effect of fruit bagging with cloth bag on edible fruit weight of Bitter gourd

The edible weight of the harvested fruit of Bitter gourd, cloth bagged with in a day of anthesis were significantly higher than the fruit bagged on second-third day of anthesis and unbagged. The average edible fruit weight of the fruit bagged with in a day of anthesis was 315.40g/fruit compare to 152.30g/fruit in case of the fruit bagged on 2nd-3rd day of anthesis and 11.83gm/fruit of unbagged. The average edible weight of the fruit bagged with in a day of anthesis were 338.89g/fruit in May, 325.13g/fruit in June, and 255.83g/fruit in July 2018. Where, it was 209.44g/fruit, 150.2g/fruit, 71.83g/fruit for bagged on 2nd-3rd day of anthesis, and 31.11g/fruit, 5.00g/fruit, 00.00g/fruit for unbagged in May, June, and July respectively (Table 5, Figure 5).

Table 5. Effect of treatments on edible weight of bitter gourd fruit, Nagarjun-1, Kathmandu, 2018

Treatments	Edible weight (gm)
Fruit bagged within a day of anthesis	315.40c
Fruit bagged on 2nd-3rd day of anthesis	152.30b
Control (non bagged)	11.80a
CV	32.5
LSD	26.68
Grand mean	159.8

Note: Means followed by the same small letters in a column are not significantly different by DMRT (≤0.05 level).

The average edible fruit weight of the fruits were 51.71% lower in case of the fruit bagged on 2nd-3rd day of anthesis and 96.25% lower for unbagged compare to the fruit bagged with in a day of anthesis. The lowerness of edible fruit weight were increasing over the months. The average edible weight of the fruit bagged on 2nd-3rd day of anthesis and unbagged were lower by 38.20%, 53.80%, 71.92%, and 90.82%, 98.46%, 100.00% in May, June, and July, respectively. Reduction of edible fruit weight over the months was mainly because of the heavy rain in mansoon and the population pressure of fruitfly as well (Table 5, Figure 5).

All the weight of the harvested fruit (100%) in case of the cloth bagged with in a day of anthesis were edible and completely protected from the fruit fly. Where on an average 73.42% weight of the fruit, bagged on 2nd-3rd day of anthesis and only 10.43% fruit weight from unbagged were edible. Rest 26.58% weight of the fruit bagged on 2nd-3rd day of anthesis and 89.57% fruit weight from unbagged were not edible and damaged by cucurbit fruit fly. The ediblity in case of the fruit bagged on 2nd-3rd day of anthesis and unbagged were decreased significantly over the months where it was constant and was 100% with the fruit bagged with in a day of anthesis. The editability of the fruit bagged on 2nd-3rd day of anthesis and unbagged were 92.63%, 68.84%, 47.10%, and 23.79%, 4.56%, 00.00% in May, June, and July, respectively (Figure 6).

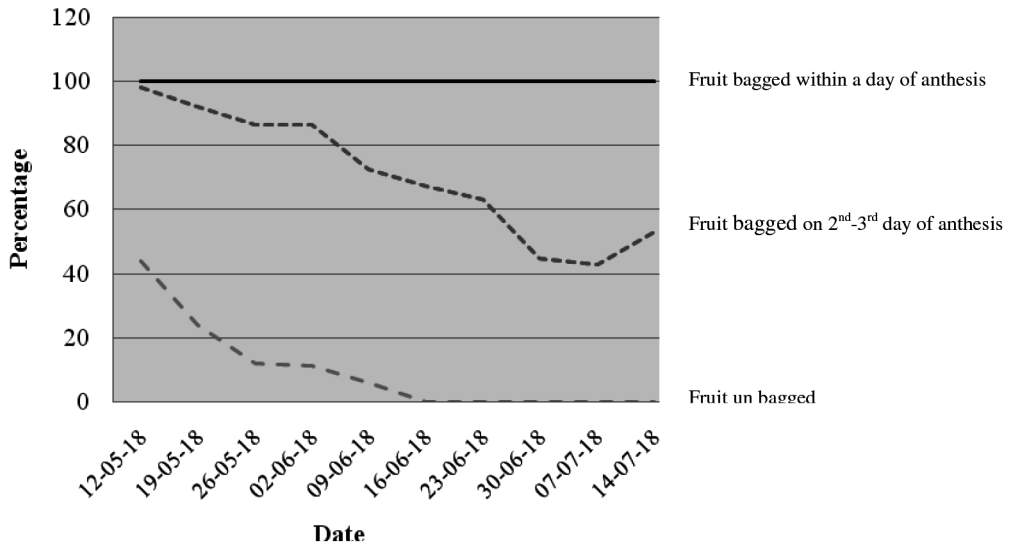

Figure 6. Edible weight (%) of the Bitter gourd fruit, Nagarjun-1, Kathmandu, 2018

CONCLUSION

Cucurbit fruit fly is a serious pest of Bitter gourd in Kathmandu valley. Adoption of management practices is most important. Chemical control of fruit fly is not only dangerous to human health, but is equally dangerous to agro-ecosystem services. Use of pheromone and mass trapping cannot give perfect management to this pest. Fruit bagging with cloth bag within a day of anthesis and wait for 10 days is recommended for the perfect management of this pest. Delay bagging on 2nd to 3rd day and wait up to 10 days of anthesis can also give the fairly satisfactory results against control (un-bagged).

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