COMPARATIVE STUDY OF INSECTICIDAL ACTIVITIES OF BIO-PESTICIDE AND CHEMICAL PESTICIDE ON THE GROWTH OF *MOMORDICACHARANTIA*L. (BITTER GOURD)

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خلاصہ

موجودہ تحقیق کا مقصد پاکستان کی معروف اور عام سبزیوں اور پھلوں پر روز بروز تیزی سے استعمال ہونے والی کیمیا ئی حشرات کش ادویات کے منفی اثرات کی طرف توجہ مبذول کروانا ہے۔اس تحقیق میں کریلے پر استعمال کی گئ کیمیائ اور حیاتیاتی کیڑے مار ادویات کا موازنہ کیا گیا ہے۔یہ تحقیق جولا ئ تا نومبر 2017 کراچی پاکستان میں منعقد کی گئ۔اس تحقیق میں کریلے کے پودوں پر حشرات لارض کے حملوں کی روک تھام پر کام کیا گیا ہے۔اس تحقیق میں حشرات لارض کے ہونے والے حملوں، کریلے کے بیجوں کی افزائش کے وقت کے ساتھ ساتھ ان کی نشو نما میں بڑے اور چھوٹے پیمانے پر تفریق پا ئ گئ۔حیاتیتی حشرات کش دوا سولانم نیگرم کے پودوں میں بیجوں کی تیز افزائش،پتوں کی تعداد میں حیران کن اضافے کے ساتھ تنے کی نشو نما میں تیزی ریکارڈ کی گئ۔جبکہ کیمیائ کیڑے مار دوا والے پودوں میں بیجوں کی افزائش انُظباطی بیجوں سے بھی زیادہ سست رو ئ کا شکار رہی۔انُظباطی پودے میں پھولوں اور پھلوں کو ابتدا میں دیکھا گیا مگر ان کا دورانیہ موسمیاتی اور دوسرے عوامل کی وجہ سے بہت ہی کم عرصے رہا۔سب سے زیادہ حشرات لارض انُظباطی پودے میں ریکارڈ کئے گئے۔جس کا تناسب ۴۶ فیصد رہا جبکہ سب سے کم حشرات الارض کی مقدار حیاتیتی کیڑے مار دوا والے پودوں میں دیکھی گئ جس کا تناسب ۳ فیصد رہا۔اور اس مَیں کسی بھی قسم کی مٹی سے ہونے والی بیماری نہیں پائ گئ جبکہ سورج کی روشنی اور جگہ کے اثرات بھی نوٹ کیے گئے۔

Abstract

The aim of present research is to increase the awareness about the hazardous effects of synthetic pesticide on common vegetables and fruits of Pakistan. The synthetic pesticide is compared with bio-pesticide, extracted by *Solanum nigrum* L. which is treated on the seeds of Bitter gourd (*Momordica charantia* L.). The study was done in Karachi Pakistan from July to November 2017, insect infestation was also observed. The major and minor differences were observed during germination and growth. The fastest germination, stem growth and larger number of leaves were observed in bio-extract treated seeds, whereas the chemical pesticide treated seeds showed the slow rate of germination. Controlled plants showed better growth as compare to the chemical pesticide treated seeds. Flowers and fruits were observed in controlled plant but fruits were died rapidly because of the inappropriate environmental conditions. Highest insect infestation rate was observed in controlled plant which was 46% and lowest insect infestation rate was observed in bio-extract treated plants which was 3%. The effect of sun light and experimental covered area was also investigated. Any kind of soil disease was not observed.

Key words: *Solanum nigrum* L., synthetic pesticide, bitter gourd, bio-pesticide

Introduction

In Pakistan, awareness of injurious effects of chemical pesticides is increasing day by day and there is a sufficient need to apply some alternatives to reduce the use of chemical pesticides that should be environmental as well as friendly for human health. Therefore the purpose of present study is to promote the use of bio-pesticides instead of chemical pesticides on plants and to encounter the efficacy of essential oils against insect pests of bitter gourd.

Farmers use different synthetic insecticides for numerous harmful pest control, which apply even in a dilute concentrations affects the soil, eco-friendly microbes, environment and on human health (Filimon, *et al.*, 2015). They effect negatively in water, soil, air and important fauna (Das, *et.al.*, 2017). Chemical pesticides deposit in soil, crops and environment and these depositions cross the limits of risks (Kumar, *et al.*, 2017) and it was observed that 20,000 – 40,000 human die due to cancer caused by the use of chemical pesticides deposited on food (Pravalika, *et al.*, 2017). Use of bio-extract pesticides is increasing day by day, those are ecosystem and environment friendly, with non-lethal activities for soil, crops, human and animal health, they are cheap and easy to manufacture (Mpumi, *et al*., 2016).

The bio-pesticides are natural enemies of insects and their products such as phytochemicals and microbes products can be helpful for controlling the pests that are harmful to plants (Mazid, *et al.*, 2011). Species of

Momordica L.have a broad range of medicinal value, originated from the eastern Asia, eastern India and areas of southern China (Nagarani, *et al.,* 2014). The Epilachna beetle (Muslant) is the main pest of bitter gourd growth, its larvae and adults are responsible for chewing the bitter gourd leaves and suck the plant juices, its growth is controlled by several synthetic pesticides. (Rahaman, *et al.,* 2008).

Natural pesticides, i.e., Neem extract, castle leaf extract etc. are against insects which do not show any side effect on the growth of bitter gourd (Rahaman, *et al.,* 2008).In Pakistan fruit flies are the major cause of yearly loss of fruits and vegetables. Over US$ 200 million, different chemicals are used to kill the adults of fruit fly (Ali, *et al*., 2011). Pakistan is practicing huge amount of synthetic pesticides to enhance its agriculture production but a few Organo- chlorine pesticides are banned in Pakistan because of their adverse effects on plants (Munawar and Hameed, 2013). The tephrosia leaf extract act as a repellent and inhibit insects to feed on plants and sometimes act as a killing agent and is lethal to insect pests (Rahaman, *et al.,* 2008). Neem extract acts as a biopesticide and consists of several different types of chemicals can easily effect on the digestive and reproductive systems of several important insect pests (Gupta and Dikshit, 2010.).Now a days pest control strategies largely depend on the use of broad spectrum pesticides in union with the food temptation that generally target adults, bio-pesticides include many types of pest management mediation through chemical, parasitic and predatory alliance and have no harmful effects and produce more positive effects than chemical pesticides in long term and they are biologically degradable (Sarwar, 2015.). *Solanum* species is considered as a medicinal plant and has exclusive bio-chemicals which control the diseases and capable of antibacterial richness. (De Britto *et al*, 2011).

Materials and Methods

Take 7 pots with 10 inches height and 8 inches in diameter size for the experiment. From the 7 pots 1 pot was used for control, 3 for bio-extract treated bitter gourd seeds and 3 for chemical extract treated seeds. Add 50% sand soil (balo-mitti) and 50% cow dung in each pot.

Take 6 beakers in which 3 beakers were marked as R_1 (replica 1), R_2 (replica 2) and R_3 (replica 3) for bio-extract and other 3 beakers marked as R_1 , R_2 and R_3 for chemical pesticide. Add 5ml distilled water in each beaker. Add 1ml *Solanumnigrum* (L) bio-extract in replicates of bio-extract and add 1ml chemical extract in each chemical pesticide labelled beakers, mix well. Add 4 fresh bitter gourd seeds in each beaker and mix well, leave them for 30 minutes. After 30 minutes, discard the liquid. After 4 hours of treatment the seeds were sown in their respective pots. These seeds were sowed on July 2017. The temperature of Karachi was 30-35°C and humidity in air was 79%.The depth of sowing was approximately 2 cm. All pots were watered after sowing.

Results and Discussion

Controlled plant growth and insect detection: Table.1:The growth rate of controlled plant was better than treated plants, germination rate was 100%. During first 3-4 weeks the rapid growth of plant was observed. The flowers and fruits were appeared but rapidly died due to the inappropriate environmental conditions From August to September the growth rate seldom constant and no rapid growth occurred in controlled. In the mid of October plant started to dry and died within 15 weeks. The overall rate of insect detection on controlled plant was 46% (Fig.1). In the month of July eight insects were observed and it was the minimum rate, 11 insects were observed in August and 15 and 12 insects were detected in September and October 2017 respectively.

Table 1. Control plant growth of stem and No. of leaves from 12th July to 21st October 2017

	S1	L1
Mean	145.50	66.07
Std. Error of Mean	23.790	10.883
Median	183.50	73.50
Std. Deviation	89.016	40.721
Variance	7923.808	1658.225

Bio-extract treated plant growth and insect detection: Table.2: Three replicates of bio-extract treated plants showed different growth rates depending on germination of seeds in each replica because in 100% germination replicate growth rate was slower because of lack of space in pot. The (R_1table.2) showed only 25% germination rate. First few weeks indicated the slower growth of plant (Fig.2) as the time preceded the length of stem was rapidly increased but flowers were not produced because of the lack of space. In the last week of October the plant started to dry and in the first week of November the plant completely died and duration of its growth was 16 weeks.

Table 2. Bio-pesticide treated seeds replica 1 growth of stem and No. of leaves from 12th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	86.83	.00	.00	.00	31.42	.00	.00	.00
Median	95.50	.00	.00	.00	35.50	.00	.00	.00
Std. Deviation	32.929	.000	.000	.000	12.034	.000	.000	.00
Variance	1084.333	.000	.000	.000	144.811	.000	.000	.000

In Table.3: R_2 100% germination was recorded but variable growth rate was observed at different time intervals. In July and August plants germinated from S1 and S2 showed great variability in their stem growth and leaves emergence (Fig.3). Whereas plant germinated from S3 showed moderate growth rate, but plant germinated from S4 showed consistency in its stem growth and leaf emergence. In September the growth rate of plant 1 and 2 were rapidly decreased but in plant 3 and 4, growth rate was increasing continuously. In October the plant 1 and 2 were started to dry and plant 1 died in first phase of mid of October and in the second phase plant 2 completely dried. But plant 3 and 4 died in the first week of November (Table.3)

Table 3. Bio-pesticide treated seeds replica 2 growth of stem and No. of leaves from 12th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	89.38	80.80	86.56	58.79	27.44	20.00	19.13	24.50
Std. Error of Mean	16.793	17.706	19.770	9.094	5.246	4.397	3.826	3.826
Median	103.50	70.50	63.50	66.00	28.00	20.00	18.50	28.50
Std. Deviation	67.171	70.825	79.080	36.377	20.986	17.588	15.305	15.306
Variance	4511.992	5016.187	6253.596	1323.283	440.396	309.333	234.250	234.26

The R_3(table.4) pot showed 75% germination rate. After germination plants showed great variability in their stem growth and number of leaves. But plant germinated from seed 3 did not show rapid growth in the first week. In August and September number of leaves rapidly increases and stem length was recorded in plant 1, 2 and 3 (Fig.4). In October plants 1 and 2 did not have any noticeable growth but plant 3 exhibited apparent stem and leaf growth. In the end of October plants 1 and 2 completely died but plant 3 was died at the beginning of November (table.4) Flowering had not been noticed in any seed.

Table 4. Bio-pesticide treated seeds replica 3 growth of stem and No. of leaves from 12th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	148.313	102.780	71.93	.00	36.40	31.53	24.60	.00
Std. Error of Mean	23.0237	16.7638	12.726	.000	5.464	5.299	4.151	.000
Median	185.000	131.000	90.00	.00	43.00	39.00	29.00	.00
Std. Deviation	89.1702	64.9261	49.287	.000	21.162	20.525	16.075	.000
Variance	7951.330	4215.397	2429.210	.000	447.829	421.267	258.400	.000

In Fig.1 the insect detection rate on bio-extract treated plants was low. Overall rate of insect detection on bio-extract treated replicates were 3%. In July, September and November no insects were detected butin August only one insect was observed whereas in October two insects were detected

Chemical pesticide treated plant growth and insect detection: Table 5: Three replicates of chemical pesticide treated plants did not show any difference in their growth ranges due to the lower rate of germination and overall growth was poor and debilitated mentioned in Fig.(5 to 7). The R_1 showed 100% germination rate. All 4 seeds were germinated and showed noticeable stem growth, but leaf emergence was slowed down in first few weeks and in the last week of August, stem size rapidly increased (Fig.5), but in September and October no noticeable growth appeared in plants 1, 2 and 3 but moderate stem growth appeared in plant 4. In the last week of October plants 1 and 3 died completely and in the first week of November plant 2 and 4 also died.

Table 5. Chemical-pesticide treated seeds replica 1 growth of stem and No. of leaves from 12th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	207.56	130.84	61.09	43.99	41.56	29.56	22.88	20.81
Std. Error of Mean	26.855	18.830	10.364	7.140	5.331	4.135	3.519	3.043
Median	260.50	166.00	70.50	45.50	52.00	35.50	26.00	27.50
Std. Deviation	107.418	75.322	41.457	28.562	21.323	16.541	14.075	12.172
Variance	11538.663	5673.391	1718.656	815.762	454.663	273.596	198.117	148.163

(Table.6) In pot R_2 , germination rate was only 25%. Only one seed was germinated and growth was poor because of the presence of high potency of chemicals. Not a single leaf emerged during whole growth period and within 2 weeks plant completely died.

Table 6. Chemical-pesticide treated seeds replica 2 growth of stem and No of leaves from 12th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	.60	.00	.00	.00	.00	.00	.00	.00
Std. Error of Mean	.349	.000	.000	.000	.000	.000	.000	.000
Median	.55	.00	.00	.00	.00	.00	.00	.00
Std. Deviation	.698	.000	.000	.000	.000	.000	.000	.000
Variance	.487	.000	.000	.000	.000	.000	.000	.000

Table.7 R_3 germination rate was 50% and growth of germinated seeds was not good and appreciable. All germinated plants were weak and did not show noticeable growth (Fig.7). A few leaves emerged during their growth period. All plants completely died rapidly.

Table 7. Chemical-pesticide treated seeds replica 3 growth of stem and No of leaves from 2th July to 15th November 2017

	S1	S2	S3	S4	L1	L2	L3	L4
Mean	1.94	7.13	.00	.00	.00	2.00	.00	.00
Std. Error of Mean	.691	2.935	.000	.000	.000	.926	.000	.000
Median	2.00	3.00	.00	.00	.00	1.00	.00	.00
Std. Deviation	1.954	8.301	.000	.000	.000	2.619	.000	.000
Variance	3.817	68.911	.000	.000	.000	6.857	.000	.000

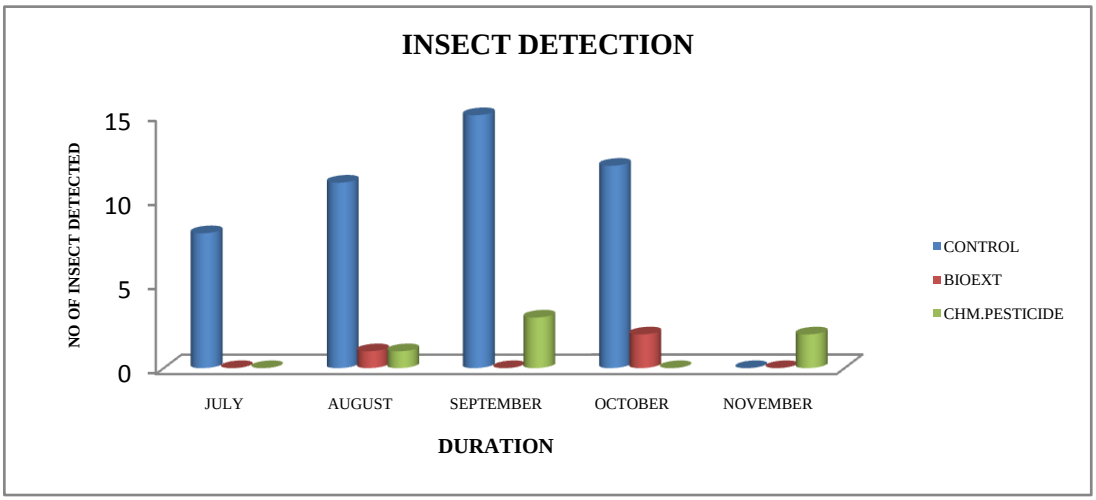
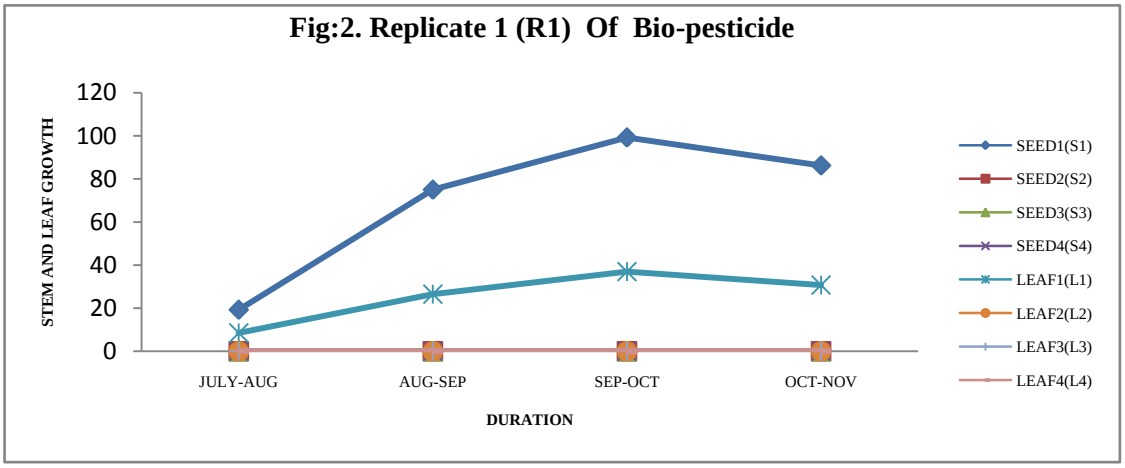
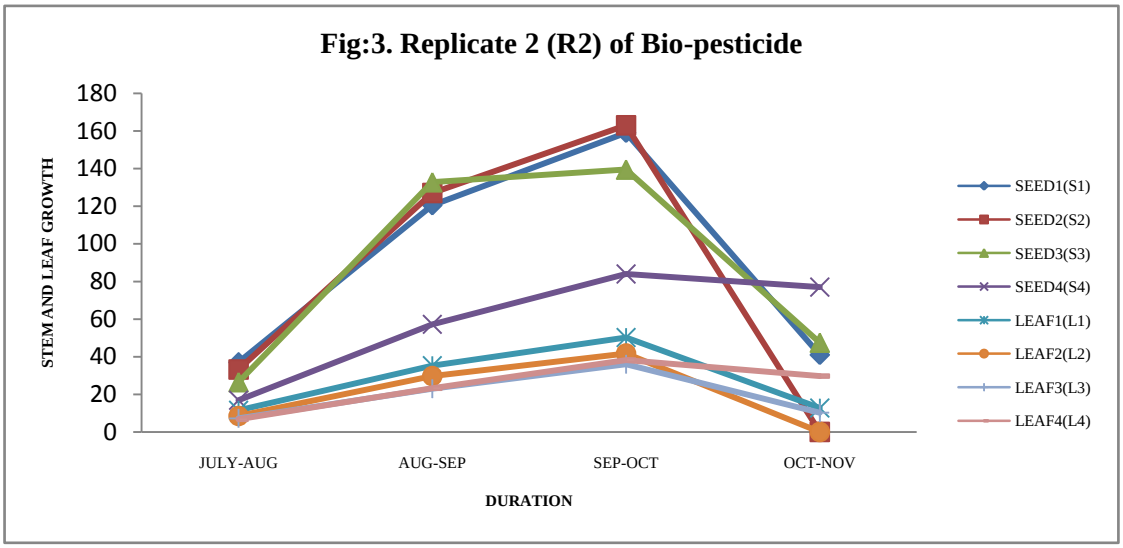


Fig.1. Insect detection on replicates of bio-pesticide, chemical pesticide and controlled plant





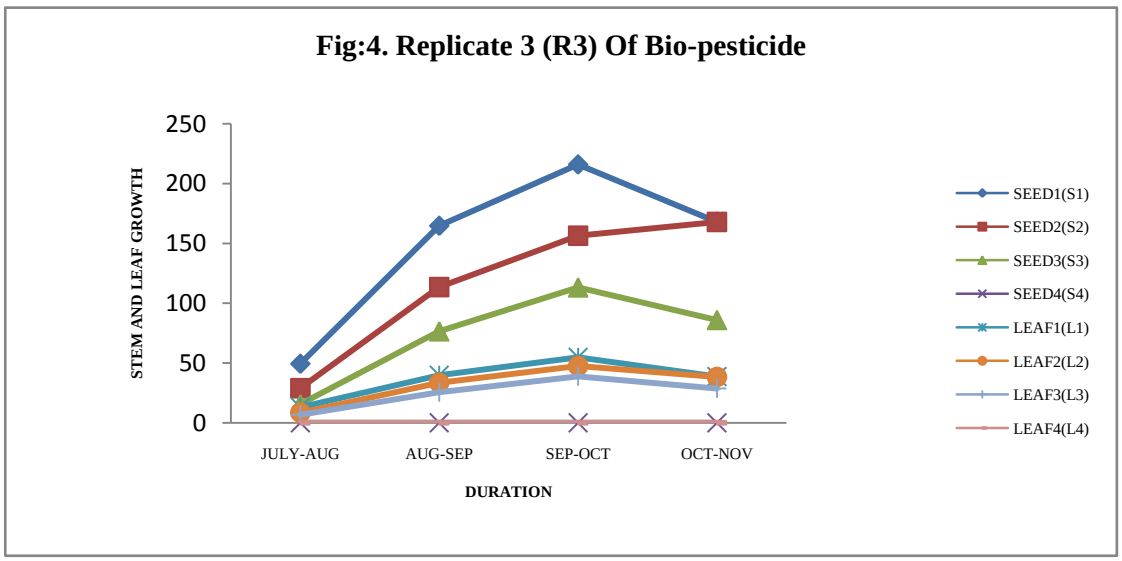
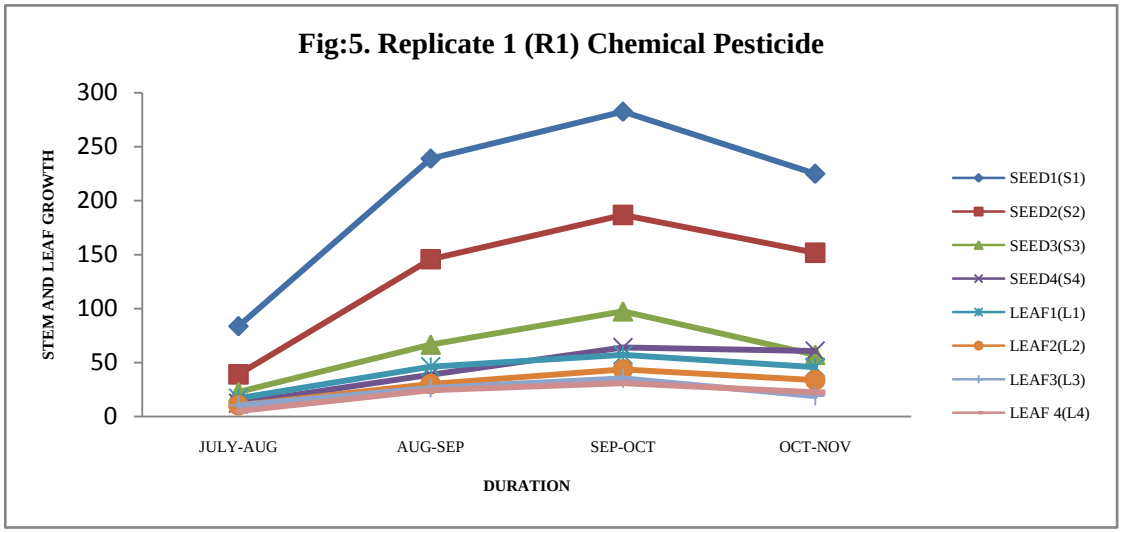
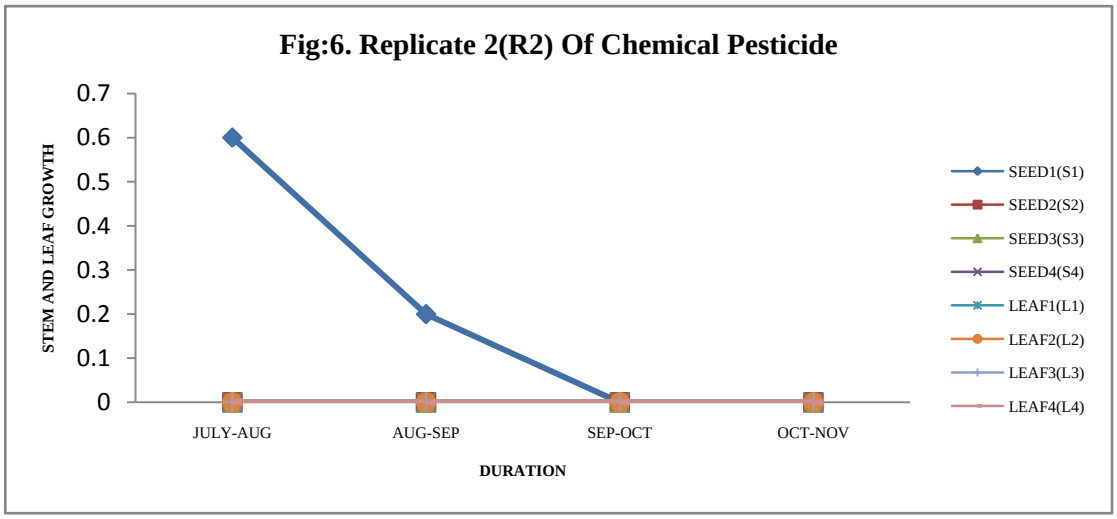


Fig.(2to 4). Showing growth of stem and no of leaves on replicates (R1, R2) of Bio-pesticide plants from July to November 2017





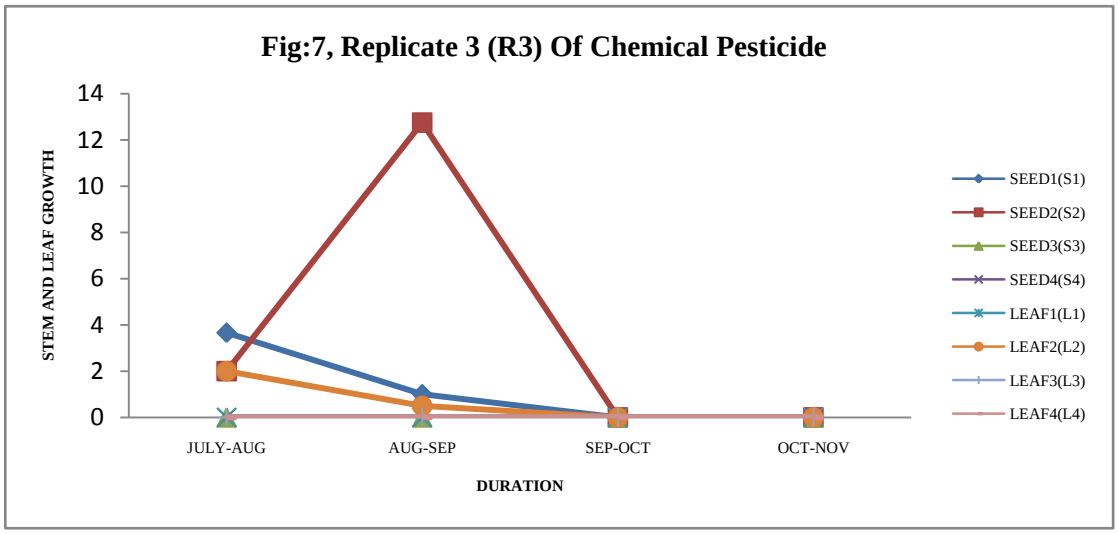


Fig.(5to 7). Showing growth of stem and no of leaves on replicates (R1,R2, R3) on chemical pesticide from July to November 2017

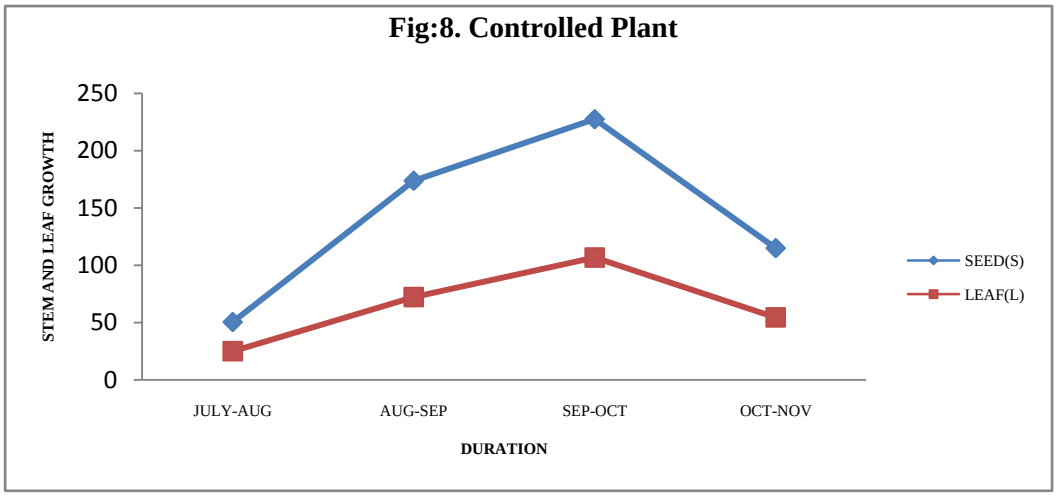


Fig. 8. Showing growth of stem and no of leaves on control plant from July to November 2017

According to Pakistan Bureau of Statistics (PBS), import of synthetic insecticides is increasing yearly. The present proposal will reduce the import load of pesticides.

(Kaya *et al.,* 2006) used the sunflower (*Helianthus annuus* L.) treated seeds, results indicated that germination delayed in both chemical solutions and showed different germination ranges with different treatments. Mean germination time and abnormal germination percentage was lesser. Seed were capable to germinate at all chemical replicates, but no seed germination occurred in bio-pesticide treated replicates. But recent research showed that bio-pesticide *S. nigrum* treated seeds showed higher germination rate whereas chemical pesticide treated seeds showed lower germination rate.

(Wang *et al.,* 2003) observed the effects of warm water soaking and matri-conditioning treatment on anti-oxidative activities of germinating *M. charantia* seeds. All the treated and un-treated seeds were germinated at 20 to 25°C. Results indicated that the sub-optimal temperature of 20°C decreased germination rate. Whereas the recent research showed that bio-pesticide treated bitter gourd seeds were germinated between 30-34^{O}C with increased rate of germination whereas chemical pesticide treated seeds germination rate was low.

(Gandhi, *et al.*, 2006) observed that insecticidal seed treatment is a supernumerary method to spray with granular applications. It can easily save the crop right from germination to reproductive stage. They observed that oil treated plants recorded minimum population of sucking pests. But the presented research indicated that *S. nigrum* can easily prevent melon flies and aphids and it also enhanced the growth rate of treated seeds of bitter gourd.

Therefore following observations suggested that the insecticidal effects of *S. nigrum*. bio-extract is more effective and eco friendly than chemical pesticide. The observations showed that *S. nigrum* not only control the insect infestation but also showed beneficial effects on germination and enhanced growth rate of bitter gourd plant as compared to chemical pesticide treated plants. Pre sowing seed treatment, of chemical pesticide slow the germination rate on bitter gourd seeds as compared to controlled plant. Bio-extract treated replicates showed slowest growth rate in few initial weeks after germination as compared to controlled plants but after few weeks they showed fastest germination occurred. Whereas chemical pesticide treated plants showed negligible growth in its two replicates. Highest insect detection rate showed on control plant, that was 46% as compared to chemical pesticide treated plant that was 6% whereas lowest insect detection was observed on bio-extract plant that was 3%. Fruit and flower emerged in controlled plant but died rapidly due to insect infestation and shortage of space. Climatic conditions were affected on the growth of plants whereas size of pots, sunlight penetration and area also effected on the growth of treated and untreated replicates.

Conclusion

On the basis of above mentioned results it has been concluded that the pre-sowing treatment of different types of seeds with bio-extracts can be helpful in protecting plants from major pests infestation, as well as bio-extracts can also be used as seed dressers to enhance germination rate of plants and provide healthy and contaminated free vegetables. It is also being suggested that the future research should be based on the encouragement of the use of bio-extracts as a seed dresser in agricultural sector that act as a replacement of major chemical seed dressers.

Illustration of table:

S1: stem size of seed 1, S2:stem size of seed 2, S3:stem size of seed 3, S4: stem size of seed 4.
L1: no of leaf of seed 1, L2: no of leaf of seed 2, L3:no of leaf of seed 3, L4:no of leaf of seed 4.

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