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Effect Of Different Pesticide against White Fly (*Bemisia Taba*) *Sucking* Insect Pests of Pistachio in District Mastung, Balochistan.

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Abstracts: *Field evaluation of various insecticides was carried out during 2017-18 against different insect pests of pistachio, in district Mastung (Balochistan). The tested pesticides include Superacide, Acetamiprid and Carbosulfan; while winter oil was also kept as a treatment which is commonly applied in the study area and Control was kept to compare the insecticidal efficacies. The efficacy of these pesticides was evaluated against whitefly, insects. The results show that insect pest population was significantly differed on pistachio trees sprayed with different insecticides. On the basis of pre-treatment count, the 1st and 2nd spray efficacy of Acetamiprid against whitefly was highest (93.38 and 94.71%), followed by Carbosulfan (60.12 and 58.87%), Superacide (56.68 and 58.15%) and winter oil (46.85 and 52.72%). Against thrips, the 1st and 2nd spray efficacy of Carbosulfan was highest (90.50 and 88.71%), followed by Superacide (80.78 and 78.89%), Acetamiprid (62.46 and 60.45%) and winter oil (56.18 and 57.21%). Against scale insects, the 1st and 2nd spray efficacy of winter oil was highest (99.78 and 99.83%), followed by Carbosulfan (52.64 and 49.76%), Acetamiprid (43.54 and 40.01%) and Superacide (36.34 and 38.44%). However, against whitefly Acetamiprid remained most effective; efficacies on pistachio. Ranking of insecticides on the basis of efficacy showed that against whitefly the pesticides were ranked as Acetamiprid> Carbosulfan> Superacide>winter*

Keywords; pistachio, scale insects, pesticides, insecticides

INTRODUCTION

Pistachio, *Pistacia vera*, is a nut fruit of high economic importance in the Anacartdiaceac plant family. The name pistachio is derived from Persian world "Pista" and nthis has been cultivated in the Iran and surrounding regions extensively. Other species cultivated include *P. terelanthus*, *P. atlantia*, *P. motica* and *P. chinesis.* It originates in China, mid Asian region, Aljeria and Mediterrranean region. Pitachio is more commonly cultivated in Italy, Spain, France, Palestine, Iran, Pakistan, and in various parts of Unites States (PARC, 2018). Pakistan ranks 15th in Pistachio production (682 tons); but ranks 1st in yield per hectare (34145 kg ha^{-1}); while Iran in on top of Pistacho producing countries of the world; followed by USA, China, Turkey, Syria, Greece, Spain, Italy, Tunisia, Madagascar, Afghanistan, Australia, Kyrgyzstan and Uzbekistan (FAOSTAT, 2017). Pakistan has tremendous potential pistachio farming and particularly entire Balochistan province has incredible potential of pistachio farming. However, only 200-300 hectares are under the pistachio cultivation in the province (Khan, 2015). In 2008, the pistachio production of Pakistan was 773 tons but in 2014 production declined to 659 tons. Regardless of tremendous production potential, Pakistan has a tiny share in world production that is only 0.1 percent (FAOSTAT, 2014).

Pistachio tree is generally infested by numerous insect pests at its entire growth stages; and the common pistachio insect pests included *Pistachio psylla*, *Agonoscena Pistaciae*; *Kermani apistaciella* and *Acrosternum heegeri*, *Acrosternum millieri*, *Apodiphus amygdali*, *Brachynema germari*, *Brachynema segetum*, *Lygaeu spandurus*. The phytophagous insects also attack pistachio which mainly include mites fruit moth, *Recurvaria pistaciicola*; *Idiocerus stali*, fruit scale, *Pistaciaspis pistaciae*, the trunk and branch scale, *Melanaspis inopinata*; the bark beetle, *Hylesinus vestitus*; leaf borer, *Ocneri aterebinthina and* common mites, *Tenuipalpus granati*. The third group phytophagus include *Megagonoscena viridis*, root beetle,

Capnodis cariosa hauseri, weevil, *Polydrusus davatchi*, eriophyid mites, *Aceria pistaciae, A. stephanii*; fruit hull borer, *Arimania komaroffi;* carob moth, *Ectomyelois ceratoniae*; leaf miner, *Stigmella promissa*; soft scale, *Anapulvinaria pistaciae*; spherical scale, *Eulecanium rugulosum*; Noghi scale, *Salicicola pistaciae*; seed wasp, *Eurytoma Plotnikovai* and pistachio seed chalcid, *Megastigmus pistaciae* (Mehrnejad, 2001; Bolkan *et al.*, 1984; Bostock *et al.*, 1987; Farivar-Mehin, 1997; Hashemi-Rad and Safavi 1996; (Mehrnejad, 1993; Mehrnejad, 1995; Mehrnejad, 1998; Mehrnejad and Daneshvar, 1991a; Mehrnejad and Daneshvar, 1991b; Michailides and Morgan, 1990). In Pakistan, the pistachio is cultivated mostly in Balochistan and in some parts of KPK. In Balochistan, the pistachio is infested by whitefly, thrips, aphid, mites, spiders, mealy bug and many scpecies of scale insects. The pistachio foliage is devasted by whitefly and thrips; while scale insects and mbark beetles generally attack the barks and fruits (Hanif, 2019).

Chemical control of insect pests is yet an effective tool to deal with; and with the introduction of new insecticides, their efficacy level needs to be evaluated time to time to ensure their quality and efficacy to control insect pests. There are a number of insecticidal groups used to combat insect pests. Nevertheless, many of the insect and thrips pests of pistachio can be controlled by chemical control using different pesticides. Fajun *et al.* (2018) reported that imidacloprid controlled *D. citri* on pistachio and suggested that use of systematic iunsecticides to control pistachio insect pests is essential to achieve quality produce. Mostafavi *et al.* (2017) showed that insect pests were exposed to different chemical control programs and recommended insecticide resistance management programs. Seyyed *et al.* (2016) reported that *Agonoscena pistaciae* is important pest of pistachio and this was only effectively controlled by chemical pesticides. Yanlk and Yildirin (2016) reported that management of *Kermania pistaciella* and twigs decreased (50.16-5.01%) in pistachio subjected to mass trapping. Zahra *et al.* (2016) reported that *pistachio psyllid* infestation was higher significantly in the upper and middle parts of the tree canopy compared with the lower parts. Amirzade *et al.* (2014) suggested that thiamethoxam is the best insecticide for control of *A. pistaciae* in combination with predatory lady beetles. Sheibani and Hassani (2014) reported that synthetic insecticides (Palizin) combat *Psyllid pistachio* effectively; followed by garlic extract, pepper extract and eucalyptus extract.

In Mastung district of Balochistan, the Pistachio is attacked mainly by scale insects; while thrips and white fly are among the minor insect pests. Reportedly Supracide, Methidathion, Methiathion, Acetamiprid, Carbosulfan are used against scale insects; while Panadublin, Prapergit and Abamectin are used against scale insect. However, Propenophos and Carbosulfan are found effective against sucking insect pests attacking pistachio (Anon, 2018). The use of pesticides such as Phosalon (2.5–3%) or diazinon (2%) with mineral oil (2%) against *K. pistaciella* pupae caused parasitoids mortality, and due to the hard coating of cocoon, the efficiency of those pesticides is not more than 70%. The use of ethion or diazinon (1.5–2%), zolone or endosulfan (2.5%) with oil (5–7%) coincided with the peak of moth flight against adults and eggs have the lowest risk for natural enemies in the middle of April. In addition, the use of Thiodicarb (1.5– 2%), zolone or darton (2.5%) or metasystox (1.5%) against eggs and neonate larvae is so dangerous for natural enemies (Yazdani, 2001). Since the susceptible stage of *K. pistaciella* to insecticides is the larval stage which is penetrated into plant tissues and less exposed to treated area, it is not a suitable control method. Yazdani (2001) recommends an integrated pest management that included mechanical control, collection and burning of dried branches in the gardens until late March, cultural control with improved soil, regular irrigation and supply adequate soil moisture, use of animal manner, pruning, follow planting distance, ploughing which increased the pupa mortality in soil. The proposed study was carried out to investigate the effect of different pesticides against insect pests of Pistachio at district Mastung Balochistan.

MATERIALS AND METHODS

This study was carried out during 2018 in the pistachio plantation at farmers' field at district Mastung, Balochistan.Various synthetic pesticides and locally used winter oil was applied as chemical control against White fly (*Bemisia tabaci*); the test was conducted using a randomized block design with three replications of each treatment. The following pesticides were used to evaluate their efficacy against target pests on pistachio.

Preparation of botanical extracts:

Treats	**Trade Name**	**Chemical Name**	**Group**	**Dosage**
T_1	Superacide	Triefluoromethanesulfonic	Sulpher	1.00 L/100 L water
T_2	Winter oil	Methyl Salicylate	Hydrogen	1.00 L/100 L water
T_3	Acetamiprid	Mospilan	Chloropyridinyl	1.00 L/100 L water
T_4	Carbosulfan	Carbosulfan	Methylcarbamate	1.00 L/100 L water
T_5	Control (untreated)	--	--	--

The pistachio plantation was sprayed using above treatments with a knapsack hand sprayer. Five branches on each of the sample pistachio trees were selected (two branches from the bottom of the tree, two branches from top of the tree and one from the middle of the mottom) and tagged and on the basis of these five branches, the insect pest infestation was recorded. Each treatment was applied and the efficacy was examined after 3 days, 7 days and 14 days of spray and compared with pre-treatment population. One pistachio plant/tree was considered as treatment replicated three times; so a total of 15 pistachio trees were selected for spray applications. The significance of the efficacy of insecticides was evaluated using analysis of variance and least significant difference using Statistix Ver 8.1 software package.

LAYOUT PLAN OF THE EXPERIMENT

Layout: Randomized Complete Block Design
Replications: Three
Total No.of trees: 15

Treatments 05
T_1= Superacide 1.00 L/100 L water
T_2= Winter oil 1.00 L/100 L water
T_3= Acetamiprid 1.00 L/100 L water
T_4= Carbosulfan 1.00 L/100 L water
T_5= Control (untreated)

RI	**RII**	**RIII**
T_1	T_3	T_5
T_3	T_5	T_3
T_5	T_1	T_4
T_2	T_4	T_2
T_4	T_2	T_1

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RESULTS

The field evaluateons were carried out during 2017-18 to investigate the effect of different pesticides against insect pests of pistachio in district Mastung (Balochistan). The tested pesticides included Superacide, Acetamiprid and Carbosulfan; while winter oil was also kept as a treatment which is commonly applied on pistachu and almond and Control was kept to compare the insecticidal efficacies. The efficacy of these pesticides was evaluated against whitefly, *Bemisia tabaci* (Genn.), thrips, *Thrips tabaci* Lin., and scale insects mostly belonging to *Coccus hesperidum* species. The pre-treatment pest population was monitored one day before spray of each treatment; while post-treatment count of certain insect pests was done after three, seven and fourteen days of each spray of different insecticides. Five branches in each experimental tree were monitored for insect pest infestation and on the basis of insect mortality the efficacies of the insecticides were developed and the data are given in Tables 1-6.

Whitefly (*Bemisia tabaci* Genn.)

First Spray

B. tabaci population on pistachu trees sprayed with different insecticides showed significant variation when observed after three days of spray ($F=707.49$; $DF=14$; $P<0.05$); after seven days of spray ($F=709.23$; $DF=14$; $P<0.05$) and after fourteen days of spray ($F=712.40$; $DF=14$; $P<0.05$) while insignificant difference for pre-treatment count of whitefly ($F=3.72$; $DF=14$; $P=0.07054$).

The first spray post-treatment whitefly population recorded at different intervals after first spray (Table 1) indicates that in pistachu trees sprayed with insecticide Acetamiprid the whitefly population declined maximally to 2.07, 1.55 and 1.24/tree after 3, 7 and 14 days of spray over 18.74/tree pre-treatment population causing 93.38% insect mortality. The pistachu trees sprayed with Carbosulfan showed whitefly population of 11.75, 9.99 and 8.59/tree after 3, 7 and 14 days of spray over 21.54/tree pre-treatment population causing 60.12% insecticidal efficacy. The trees sprayed with Superacide caused decrease in whitefly population upto 11.85, 9.60 and 8.45/tree after 3, 7 and 14 days of spray over 19.51/tree pre-treatment insect count showing an efficacy of 56.68 percent. However, among tested insecticides, winter oil resulted in least efficacy with average whitefly population of 12.23, 10.39 and 8.94/tree after 3, 7 and 14 days of spray over 16.82/tree pre-treatment insect count showing efficacy of 46.85 percent. The whitefly population in untreated (control) was highest irrespective of insect monitoring intervals. On the basis of insecticidal efficacy, the tested pesticideswere ranked as Acetamiprid> Carbosulfan>Superacide>winter oil.

Second spray

The whitefly population under the effect of different insecticides on pistachu trees showed significant difference when recorded three days after spray ($F=1456.71$; $DF=14$; $P<0.05$); after seven days of spray ($F=1494.61$; $DF=14$; $P<0.05$) and after fourteen days of spray ($F=1494.81$; $DF=14$; $P<0.05$) while insignificant difference for pre-treatment population of whitefly was calculated ($F=2.79$; $DF=14$; $P>0.05$).

The data second spray post-treatment population of whitefly monitored at different intervals (Table 2) indicated that the whitefly population on pistachu trees sprayed with insecticide Acetamiprid remained lowest i.e. 1.44, 1.08 and 0.86/tree after 3, 7 and 14 days of spray over 16.27/tree pre-treatment population resulting 94.71 percent mortality. The whitefly population on trees sprayed with Carbosulfan was 8.59, 7.30 and 6.28/tree after 3, 7 and 14 days of spray over 15.27/tree pre-treatment population resulting 58.87 percent efficacy. The Superacide spray application decreased whitefly population upto 9.62, 7.79 and 6.85/tree after 3, 7 and 14 days of spray over 16.37/tree pre-treatment insect count showing an efficacy of 58.15 percent. However, winter oil among the treatments resulted in least efficacy with average whitefly population of 8.80, 7.48 and 6.43/tree after 3, 7 and 14 days of spray over 13.60/tree pre-treatment insect count showing efficacy of 52.72 percent. The whitefly population in untreated (control) was highest regardless of observation intervals. On the basis of insecticidal efficacy after second spray, the pesticides were ranked as Acetamiprid> Carbosulfan> Superacide> winter oil.

Table 1: Population of whitefly per tree in different plots sprayed with pesticides before and after 3, 7 and 14 days of 1st spray

Treatment	Pre-treat. count	Post treatment count			Total reduction	Efficacy (%)
		3 days	7 days	14 days		
Superacide	19.51	11.85[c]	9.60[c]	8.45[b]	11.06	56.68
Winter Oil	16.82	12.23[b]	10.39[b]	8.94[b]	7.88	46.85
Acetamiprid	18.74	2.07[d]	1.55[d]	1.24[c]	17.49	93.38
Carbosulfan	21.54	11.75[c]	9.99[c]	8.59[b]	12.95	60.12
Control	17.34	17.25[a]	16.91[a]	16.40[a]	0.94	5.42
SE±	*0.1016*	*0.2932*	*0.2895*	*02895*	--	--
LSD	*NS*	*1.6761*	*1.7676*	*1.9553*	--	--
P-value	*0.07054*	*0.0001*	*0.0002*	*0.0001*	--	--

Table 2: Population of whitefly per tree in different plots sprayed with pesticides before and after 3, 7 and 14 days of 2nd spray

Treatment	Pre-treat. count	Post treatment count			Total reduction	Efficacy (%)
		3 days	7 days	14 days		
Superacide	16.37	9.62[b]	7.79[b]	6.85[b]	9.52	58.15
Winter Oil	13.60	8.80[c]	7.48[b]	6.43[b]	7.17	52.72
Acetamiprid	16.27	1.44[d]	1.08[c]	0.86[c]	15.41	94.71
Carbosulfan	15.27	8.59[c]	7.30[b]	6.28[b]	8.99	58.87
Control	15.20	15.12[a]	14.82[a]	14.67[a]	0.53	3.48
SE±	*0.0411*	*0.1822*	*0.1786*	*0.1763*	--	--
LSD	*NS*	*1.4204*	*1.4720*	*1.4956*	--	--
P-value	*0.0812*	*0.0000*	*0.0001*	*0.0001*	--	--

DISCUSSION

Pistachio is a fruit crop of high economic significance; and Balochistan is renowned worldover for pistachio production. However, less attention has been given towards quality production of pistachio; and insect pest infestation is the major cause to affect the fruit quality of pistachio. Hence, the present study was carried out to investigate different pesticides against different insect pests of pistachio in district Mastung (Balochistan). The tested pesticides included Superacide, Acetamiprid and Carbosulfan; while winter oil was also kept as a treatment which is commonly applied on pistachu and almond and Control was kept to compare the insecticidal efficacies. The efficacy of these pesticides was evaluated against whitefly, thrips and scale insects. The major results achieved in this study are discussed in this chapter.

The study showed that whitefly population after 3, 7 and 14 days of 1st spray of Acetamiprid was 2.07, 1.55 and 1.24/tree; Carbosulfan 11.75, 9.99 and 8.59/tree; Superacide 11.85, 9.60 and 8.45/tree; winter oil 12.23, 10.39 and 8.94/tree. After second spray, the whitefly population decreased after 3, 7 and 14 days of treatment Acetamiprid (1.44, 1.08 and 0.86/tree); Carbosulfan (8.59, 7.30 and 6.28/tree); Superacide (9.62, 7.79 and 6.85/tree); winter oil (8.80, 7.48 and 6.43/tree). The 1st and 2nd spray efficacy of Acetamiprid against whitefly was highest (93.38 and 94.71%), followed by Carbosulfan (60.12 and 58.87%), Superacide (56.68 and 58.15%) and winter oil (46.85 and 52.72%). These results are agreement with those of Mehrnejad (1998) who reported that whitefly on pistachio can be effectively controlled by chemical pesticides. Mourikis *et al.* (1998), Michailides and Morgan (1990) and Fajun *et al.* (2018) reported that whitefly is a serious pest of pistachio and its control through synthetic pesticides is possible and these studies indicated that whitefly infestation can be managed effectivelyby using chemical pesticides. Seyyed *et al.* (2016) and Yanlk and Yildirin (2016) reported that combating whitefly on pistachio is challenging, but proper chemical control measures can effectively control this pest on pistachio. In the present study, Acetamiprid proved to be most appropriate insecticide to combat whitefly on pistachio on the basis of decrease in whitefly population after spray applications and winter oil (56.18 and 57.21%).

The population of scale insects decreased after 3, 7 and 14 days of first spray of winter oil (9.68, 5.32 and 4.04/tree); Carbosulfan (370.51, 351.98 and 337.90/tree); Acetamiprid (510.65, 485.12 and 412.35/tree); Superacide (585.90, 533.17 and 469.19/tree). After second spray, the population of scale insects declined after 3, 7 and 14 days of treatment i.e. winter oil (156.40, 7.82 and 1.25/tree); Carbosulfan (379.58, 360.60 and 346.18/ tree); Acetamiprid (499.16, 474.20 and 403.07/tree); Superacide (521.26, 474.34 and 417.42/tree). The 1st and 2nd spray efficacy of winter oil was highest (99.78 and 99.83%), followed by Carbosulfan (52.64 and 49.76%), Acetamiprid (43.54 and 40.01%) and Superacide (36.34 and 38.44%). Similar results have also been reported by many past workers who have worked in different parts of the world. Zahra *et al.* (2016).

SUMMARY

In order to investigate different pesticides against different insect pests of pistachio, the field evaluation was carried out during 2017-18 in district Mastung (Balochistan). The tested pesticides included Superacide, Acetamiprid and Carbosulfan; while winter oil was also kept as a treatment which is commonly applied on pistachu Control was kept to compare the insecticidal efficacies. The efficacy of these pesticides was evaluated against whitefly, insects. The findings of the study are summarized as follows:

The results show that insect pest population was significantly differed on pistachio trees sprayed with different insecticides. The whitefly population decreased after 3, 7 and 14 days of first spray of Acetamiprid (2.07, 1.55 and 1.24/tree); Carbosulfan (11.75, 9.99 and 8.59/tree); Superacide (11.85, 9.60 and 8.45/tree); winter oil (12.23, 10.39 and 8.94/tree) with average efficacy of 93.38, 60.12, 56.68 and 46.85 percent, respectively. After second spray, the whitefly population decreased after 3, 7 and 14 days of treatment Acetamiprid (1.44, 1.08 and 0.86/tree); Carbosulfan (8.59, 7.30 and 6.28/tree); Superacide (9.62, 7.79 and 6.85/tree); winter oil (8.80, 7.48 and 6.43/tree) with average efficacy of 94.71, 58.87, 58.15 and 52.72 percent, respectively.

In case of thrips population, the insect population decreased after 3, 7 and 14 days of first spray of Carbosulfan (9.68, 5.32 and 4.04/tree); Superacide (14.91, 9.10 and 8.00/tree); Acetamiprid (21.81, 18.54 and 14.83/tree); winter oil (27.92, 23.73 and 20.41/tree) with average efficacy of 90.50, 80.78, 62.46 and 56.18 percent, respectively. After

The treatment effect on pistachio yield was significant ($P<0.05$) over control (untreated). The trees sprayed with Acetamiprid produced highest pistachio yield (35.72 kg/tree); closely followed by winter oil (35.66 kg/tree); Carbosulfan (33.45 kg/tree) and Superacide (31.34 kg/tree). However, the least pistachio yield (18.75 kg/tree) was obtained in control (untreated).

CONCUSION

Acetamiprid proved to be most appropriate insecticide to combat whitefly on pistachio on the basis of whitefly population record after two spray applications.

The Carbosulfan has proved to be most effective insecticide for controlling the thrips on pistachio.The winter oil is highly effective against whiteflyt to control them timely; and with the application of winter oil, the fruit quality couyld be maintaibned. The treatments were effective to increase pistachio yield over control. However, whitefly suppression by Acetamiprid and winter oil more positively influenced the pistachio yield over rest of the treatments.

SUGGESTIONS

On the basis of research findings from the present stuydy, it is suggested that Acetamiprid may be applied to control whitefly on pistachio; while against thrips Carbosulfan may be sprayed to combat this insect pest effectively. However, for combating scale insects on pistachio, winter oil could be a single economical and effective solution to combat these insect pests on pistachio.

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APPENDICES

Whitefly first spray

Appendix-I Analysis of variance for pre-treatment count (whitefly first spray)

Soruce	DF	SS	MS	F	P
Replication	2	14.8986	7.4493		
Treatment	4	0.23114	0.05779	3.72	0.07054
Error	8	0.1239	0.0155		
Total	14	15.2536			

Appendix-II Analysis of variance for post-treatment count of whitefly three days after first spray

Soruce	DF	SS	MS	F	P
Replication	2	5.102	2.5511		
Treatment	4	364.888	91.2221	707.49	0.0000
Error	8	1.032	0.1289		
Total	14	371.022			

Appendix-III Analysis of variance for post-treatment count of whitefly seven days after first spray

Soruce	DF	SS	MS	F	P
Replication	2	3.949	1.9747		
Treatment	4	356.631	89.1577	709.23	0.0000
Error	8	1.006	0.1257		
Total	14	361.586			

Appendix-IV Analysis of variance for post-treatment count of whitefly fourteen days after first spray

Soruce	DF	SS	MS	F	P
Replication	2	3.194	1.5970		
Treatment	4	345.225	86.3062	712.40	0.0000
Error	8	0.969	0.1211		
Total	14	349.388			

Whitefly second spray
Appendix-V Analysis of variance for pre-treatment count (whitefly second spray)

Soruce	DF	SS	MS	F	P
Replication	2	4.7670	2.38349		
Treatment	4	0.0283	0.00707	2.79	0.0812
Error	8	0.0202	0.00253		
Total	14	4.9973			

Appendix-VI Analysis of variance for post-treatment count of whitefly three days after second spray

Soruce	DF	SS	MS	F	P
Replication	2	1.599	0.7997		
Treatment	4	290.439	72.6098	1456.71	0.0000
Error	8	0.399	0.0498		
Total	14	292.437			

Appendix-VII Analysis of variance for post-treatment count of whitefly seven days after second spray

Soruce	DF	SS	MS	F	P
Replication	2	1.259	0.6295		
Treatment	4	286.187	71.5468	1494.61	0.0000
Error	8	0.383	0.0479		
Total	14	287.829			

Appendix-VIII Analysis of variance for post-treatment count of whitefly fourteen days after second spray

Soruce	DF	SS	MS	F	P
Replication	2	1.021	0.5106		
Treatment	4	278.652	69.6631	1494.81	0.0000
Error	8	0.373	0.0466		
Total	14	280.046			

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