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Research Article

Faunal diversity of order Araneae species from District Dir Lower of Malakand division, Pakistan

Muhammad Sajid[1*], Muhammad Zahid[1], Abida Butt[2], Muhammad Rasool[3], Mudassar Shah[1], Riaz Ahmad[1], Waheed Murad[4], Muhammad Kamil[4], Mujeeb Ullah[1] and Ikram Ullah[1]

1. Department of Zoology Islamia College University Peshawar-Pakistan
2. Department of Zoology, University of Punjab, Lahore-Pakistan
3. Department of Zoology, Dr. Khan Shaheed Govt: Degree College Kabal Swat-Pakistan
4. Shaheed Benazir Bhutto University (SBBU), Sub-Campus Wari-Pakistan

**Corresponding author's email: Muhammadsajid541@gmail.com*

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Abstract

Spiders are ancient invertebrate belonging to class Arachnida, Order Araneae in Phylum Arthropoda. It is a diverse group of organisms that play a vital role in biological control. Present study was conducted in different areas of Dir Lower to find out the biodiversity of order Araneae. Spiders were collected from April 2018 to July 2019 by using different methods including Aerial hand collection, Ground hand beating, Hand picking, Pitfall traps and by Beat sheet method. Spiders were then preserved in 80% ethanol for morphological study and were identified to specie level by using available literature. Identified families are (Salticidae, Araneidae, Sparassidae, Scytodidae, Erisidae, Thomisidae), genera are (*Plexippus, Hasarius, Araneus, Olios, Scytodes, Stegodyphus and Thomisus*) and species are (*Plexippus paykulli, Hasarius adonsoni, Araneus mitificus, Olios stimulator, Scytodes thoracica, Stegodyphus sarasinorum, Thomisus zaheeri Crossopriza lyoni*). Most dominant family was Salticidae. The diversity of spiders in Dir lower is not explored yet and very little information's are there about the systematics, ecology and diversity. Most of the species are recorded for the first time from the area while *Hasarius adonsoni, Olios stimulator, Stegodyphus sarasinorum and Scytodes thoracica* are recorded for the 1st time from Pakistan. This study will serve as a base for further exploration of the fauna of spiders in Dir Lower and Pakistan.

Keywords: Arthropoda; Dir Lower; Salticidae; Spiders; Taxonomy

Introduction

Spiders belong to one of the largest and most diverse class of animals called Arachnida with 120 families, 4153 genera and 48393 species **[1]**. Pakistan has diverse habitat and rich in spider but no solid account of spiders still exists **[2]**. Make all citation in blue color or follow journal formate The various Localities occupied by the spider are soil, houses, forests, meadows,

woodlands, croplands, and the petals of flowers and even they may have adopted amphibious life [3]. Spiders are carnivorous and have the ability of devouring large quantity of food [4]. Latitude of Pakistan is 24º and 37º North and longitude is 62º and 75º East. It is an agricultural country, and has an important role in its economy and topography. It lies between semi-arid to subtropical climate [5]. It consist of a wide variety of niches which is home of diverse group of organisms and specially Arthropods. Among spiders some are web forming that is big source of food and is used for capturing prey. Some other species don't forming webs and they capture prey actively. They occupy wide varieties of niches and are biological indicator for environmental changes [6]. About forty Spider species are venomous and potentially deadly to human beings. They are rapacious predators and carnivorous [7]. To avoid the harmful effects on dairy and live stock in Pakistan pesticides are seldom used for controlling insect pests on fodder and crops. For this purpose biological control is done where spiders and other organisms are used to control insects without pollution causing and the product is also increased [8].

Spiders are found in various colors and sizes. They are found mostly in terrestrial ecosystem as a predator. They are found in various habitats like ground, under stones, underground tunnel systems, and near waters, but most likely they are in moist places. Their metamorphosis takes place through ecdysis (molting). Replacement of old skin with new one helps in increasing their size [9].

Materials and Methods

Study area

The present study was conducted in District Dir lower. Dir is a small former princely state situated in North of Khyber Pakhtunkhwa, 34^0 North latitude and 71^0 East latitude. Swat valley is situated on the East of Dir lower, Chitral valley at North, Bajaur and Afghanistan at west and Malakand district on its South [9].

Spider collection

This was a first comprehensive study on the spiders of Dir Lower. Different spiders specimens (more than 1500) belonging to different families were collected in various localities like plan area, riverbank, streams, hills, mountains, leaf letters, stem of plants and bushes, fields, crops, ground, underground, house, foliage, dry wood, store, loose bark of plant, rocks and marshy places namely Nagri Payeen, Nagri Bala, Pato, Barcharay hill, Laram top, Banda hill, Dramdal, Tangay hill, Hosakai Hills, Khanpur, Goro, Pingal Hills, Kamranay Hills, Lajbook and Maidan of District Dir Lower through following methods.

Pitfall trap

Cylindrical containers made of plastic were used as pitfall trap. The trapping medium was liquid containing 30% ethyl acetate, 69% water and 1% commercial detergent. The specimens that trapped in the medium were extracted after seven days. The data was then used for specie identification [9]. Rims of the containers were parallel at the ground level [10]. Each trap was covered with a plastic rain cover supported with three nails which was helpful in prevention of flooding during rain [10].

Cryptic searching

Spiders that are living in cryptic habitats like in litter, holes of the trees or logs that is fallen, bark cracks, under logs, stones and moss, within rotting trees and under logs were collected through hand collection. Sampling was done directly or by sifting the litter [11].

Ground hand collection

Spiders from ground to knee level that are visible were collected through ground hand collection. By looking down, kneeling and crawling samples on leaf litter, logs and on the ground surface were collected [11].

Aerial hand collection

For collection of spiders above knee level to as high that one can reach this method was used. Web forming spiders, spiders living on branches and leaves or on tree trunks and on high herbs were accessed through this method **[11]**.

Vegetation beating

This method was used to accesses spiders present in vegetation (high herbs, shrub, small trees, bushes and branches) below knee level. By shaking the vegetation the spiders fall into the container below and were collected **[11]**.

Preservation

Spiders collected from different localities were washed with alcohol. The washed spiders were stored in a mixture of 80% alcohol with proper labeling of locality, date of collection and other notes of importance. Some important specimens were also preserved in 100% alcohol for molecular work.

Spider identification

Identification was done by using stereo microscope to study different organs of the spiders in laboratory at the Department of Zoology Islamia College University Peshawar. The collected specimens were identified with help of available keys **[12-15]**.

Abbreviations

ALE. Anterior lateral eyes, AME. Anterior median eyes, PME. Posterior median eyes, PLE. Posterior lateral eyes, AL. abdomen length, BL. Body length, AW. Abdomen width, CL. Cephalothorax length, CW. Cephalothorax width.

Results

Present study was conducted at District Dir Lower, Khyber Pakhtunkhwa, Pakistan to find out the diversity of spiders in various habitats. The study resulted in identification of 6 families, 7 genera and 7 species of the order Araneae. All the species are recorded for the first time from study area while *Hasarius adonsoni, Olios stimulator, Stegodyphus sarasinorum and Scytodes thoracica*are for the first time from Pakistan.

1. *Plexippus paykulli* Audouin, 1826

Material studied: Nagri Payeen 3 ♂ and 5 ♀ 25. v 2018, Nagri Payeen Hill1♂, 2♀ 2. Vi 2018, Goro stream 2 ♂ and 2 ♀ 2.ix 2018, Kamranay Hill1♀ 7. iv 2019 all coll. M. Sajid.

Body measurements (male)

B.L. 7, A.L. 3.5, A.W. 1.9, C.L. 3, C.W. 2, Eyes interdistance: A.M.E.-A.M.E.0.2, P.L.E.-P.L.E. 1.4, A.L.E.-P.L.E. 0.75, A.L.E.-A.M.E. 0.1, Legs measurement: Leg I: (1.7+0.8+1.1+0.7+ 0.8), Leg II: (1.6+0.7+1+0.7+0.6), Leg III: (1.7+0.6+1.1+1.0+0.8), Leg IV: (1.8+0.7+1.1+1.3+0.9). Female: Eyes diameter: A.M.E. 0.6, P.L.E. 0.3, A.L.E. 0.3, and P.M.E. 0.12. Eyes inter-distance: A.M.E.-A.M.E. 0.2, P.L.E.-P.L.E. 1.65, A.L.E.-A.M.E. 0.15, and A.L.E.-P.L.E. 0.8.

Color and body

Sturdy and strong specie. Black and white (light) color stripes on body.

Distribution

Africa. Introduced to both Americas, Europe, Middle East, India, China, Japan, Korea, Thailand, Philippines, Papua New Guinea, Australia, Pacific Is, and Pakistan **[1]**.

Remarks

Plexippus paykulli was earlier reported from the Swat, Khyber Pakhtunkhwa **[16]**, presently it is reported from Dir Lower for the first time (Fig. 1 & 2).

Figure 1. *Plexippus paykulli* (Audouin, 1826) male

Figure 2. *Plexippus paykulli* (Audouin, 1826), Female

2. *Hasarius adonsoni* Audouin, 1826

Material studied

NagriPayeen1 ♂ 25 v. 2018, Ouch1 ♂ 25 vi. 2019, all.coll. M Sajid.

Measurement

B.L. 3.6-5, C.L. 1.6-2.6, C.W. 1.4-2.2, A.L. 1.83-2.6, A.W. 1.22-1.7, Eyes Diameter: A.M.E. 0.3-0.6, A.L.E. 0.16-0.24, P.M.E. 0.05-1, P.L.E. 0.16-0.26. Eyes interdistance: P.L.E.-P.L.E. 1.12-1.69, A.M.E-A.M.E. 1.0-1.5. P.L.E-A.L.E. 0.8-1.0, A.L.E-A.M.E. 0.32-0.51. Legs. Leg I. 2.15-3.1 (0.48-0.7+0.33-0.6+0.47-0.7+0.4-0.7+0.4-0.6), Leg II. 2.1-3.1 (0.45-0.72+0.34-0.51+0.5-0.8+0.5-0.8+0.4). Leg III. 2.29-3.4 (0.47-0.7+0.27-0.4+0.54-0.8+0.54-0.8+0.47-0.7). Leg IV. 2.3-3.8 (0.46-0.8+ 0.26-0.5+0.59-0.9+0.52-0.9+0.46-0.7).

Color

Mostly black in color with red brown cephalic region. Pedipalp is whitish in color.

Distribution

Africa. Introduced to Americas, Europe, Laos, India, China, Vietnam, Japan and now reported for the first time from Pakistan **[1]**.

Remarks

This species has no previous record from Pakistan. Present study confirmed its existence from Northern most area of the country (Fig. 3).

Figure 3. *Hasarius adonsoni* (Audouin, 1826), male

3. *Araneus mitificus* Simon, 1886

Material studied

Khanpur, Dir Lower1 ♀ 09 xi. 2018. Kamranay Hills 1 ♂ and 1 ♀ 07 iv. 2019.

Measurement

B.L. 8-9, A.L. 4-5, A.W. 4.5, C.L. 3-4, C.W. 3.42, Eyes interdistance: A.M.E.-A.M.E.0.1, P.L.E.-P.L.E. 0.1, A.L.E.-P.L.E. 0.7, A.L.E.-A.M.E. 0.25, Legs measurement: Leg I: (1.41+0.52+1.13+0.74+ 0.82), Leg II: (1.60+0.73+1+0.75+0.61), Leg III: (1.71+0.63+1.12+1.08+0.82), Leg IV: (1.81+0.70+1.11+1.35+0.90).

Habitat

They form webs, come out at night and rest on these webs to capture prey, while hide under leaves or form a tent like web where hide during day time.

Male description

Male is smaller in size then female, with body length 5-6mm.

Color

It is known as kidney garden spider. Cephalothorax is yellow-green in color. Abdomen is white with some green spots. Legs are green in color.

Distribution

India to Philippines, Japan, New Guinea, new record to fauna of Araneidae from Pakistan (Fig. 4A & B) [1].

Remarks

This is the first record of the species to spider fauna of Pakistan.

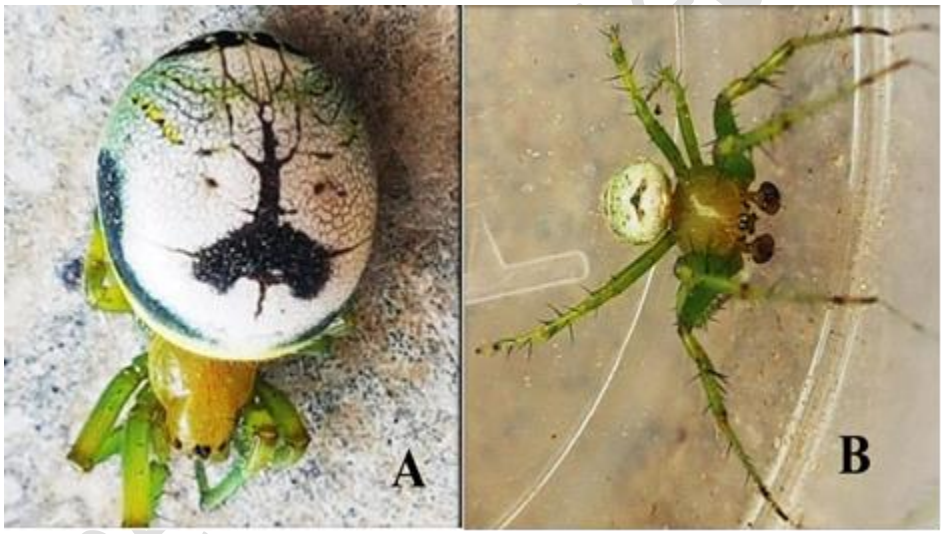

Figure 4. ***Araneus mitificus* (Simon, 1886), A. male, B. Female**

4. *Olios stimulator* Simon, 1897

Material Studied

MattaTalash 1 ♂ 29 v. 2018, Nagri Payeen hill 4 ♂ 31 v. 2018.

Measurement

BL-17, CL-7.8, CW-9.5, AL- 9.2, AW-6.5. Length of eye rows. AER-2.6, PER-2.9. Leg formula: 2143: Legs measurement: leg I: 41.5 (11.2+3.6+11+11.7+4). Leg II: 45 (12+3.5+12.5+13+4). Leg III: 30.4 (8+2.5+9+8+2.9) Leg IV: 33.5 (11+2.5+9+8+3). Eye interdistances: AME–AME 0.4, AME–ALE 0.44, PME–PME 0.6, PME–PLE 0.9, AME–PME 0.50, ALE–PLE 0.33. Chelicerae with 4 retro marginal teeth and two promarginal (one in it is bicuspid).

Distribution

only recorded from India and now reported from Pakistan [1].

Habitat

Mostly found at night on the walls. In Venter mostly observed under stones and crevices.

Remarks

This species is previously recorded from India with only male specimen and now recorded from Pakistan after 38 years (Fig. 5).

Figure 5. ***Olios stimulator*** **(Simon, 1897) male**

5. ***Scytodes thoracica*** **Latreille, 1804**

Material Studied

Nagri Payeen 1 ♀ 28 vi. 2018, Nagri Payeen 1 ♀ 22 vii. 2018.

Measurement

B.L. 5-6, A.L. 2.5, A.W. 1.5, C.L. 3, C.W. 2, Eyes interdistance: A.M.E.-A.M.E.0.2, P.L.E.-P.L.E. 0.4. Legs measurement: Leg I: (1.3+0.7+1.6+0.5+ 0.9), Leg II: (1.4+0.6+1.1+0.6+0.7), Leg III: (1.5+0.7+1.0+0.9+0.9), Leg IV: (1.8+0.6+1.2+1.2+0.9).

Distribution

Europe, North Africa, Turkey, Iran, temperate Asia to China, Korea, Japan. Introduced to North America, Argentina, India, Australia, New Zealand and now from Pakistan **[1]**.

Habitat

It is also called as spitting spiders. They are found mostly in crevices and come out at night. Also live under stones.

Color:

Brown color with black spots on their body form transverse lines.

Remarks

The species is previously not published from any part of the country. Present study confirms its distribution from Pakistan (Fig. 6).

Figure 6. ***Scytodes thoracica*** **(Latreille, 1804) female**

6. *Stegodyphus sarasinorum* Karsch, 1891

Material Studied

Baracharay hill, Dir Lower Khyber Pakhtunkhwa (KP) 2 ♀ 18 vi. 2018, Zombaqay hill, Dir Lower Khyber Pakhtunkhwa (KP) 6 ♀ 1 vii. 2018, Banda hills, Dir Lower Khyber Pakhtunkhwa (KP) 2 ♀ 05 vii. 2018, Dramdal hills, Dir Lower Khyber Pakhtunkhwa (KP) 2 ♀ 18 vii. 2018, Badwan kandar Baracharay hill 1 ♀ & ♂ 13 ix. 2018.

Measurement

B.L. 5-6, A.L. 2.5, A.W. 1.5, C.L. 3, C.W. 2, Eye interdistances: A.M.E.-A.M.E.0.13, P.L.E.-P.L.E. 1.34, P.L.E.-P.M.E. 1.17, A.L.E-A.M.E. 0.73. Leg measurement: Leg I: (2.6+1.3+1.6+2.25+ 1.2), Leg II: (2.0+1.0+1.1+1.6+0.7), Leg III: (1.5+0.7+1.0+0.9+0.9), Leg IV: (2.2+1.6+1.7+1.2+0.9).

Distribution

it is known as Indian cooperative spider that is native to India, Sarilanka, Nepal etc and now recorded from Dir lower, KP, Pakistan **[1]**.

Habitat

It is a social spider and forms a dense and big web some time cover a whole plant. Male are smaller in size than females. In early stages of life, it take part in all social activities like repair of web, snare construction, capturing of prey, feeding, nest building etc. but after maturity it take no part in these activities except in reproduction. Sub adults can be seen in web from November while mature ones from December to March. They die early then female's only one male is captured in this study while females were more common and higher in number. Male is smaller than female. *Stegdyphus* are also known as velvet spiders.

Color

White in color, sometime yellowish and brown also. The male specimen is dark in color then female. The color varies in this collection from specimen to specimen (Fig. 7A, B, C).

Remarks

This species is recorded for the first time from Pakistan with no previous record from the WSC **[1]**.

Figure 7. *Stegodyphus sarasinorum* (Karsch, 1891), A, B. Female and C. male

7. *Thomisus zaheeri* Parveen, Khan, Mushtaq, Ahmad & Rana, 2008

Material Studied

Nagri Payeen, 1♀ 1♂, 17.vii.2018, M Sajid.

Description

Male is smaller as compare to female. Male is brown in color with deep brown legs while female is yellow-green in color.

BL 2.3, CL 1.1, CW 1.09, AL 1, AW 1.2.Eyes size: AME 0.09, ALE 0.08, PME 0.69, PLE 0.069. Eyes row length: AER. 0.8, PER. 1.08. Eyes interdistance: AME-AME. 0.2, AME-ALE.0.22, AME-PME.0.35, PME-PME. 0.35. Legs formula: 1243. Legs measurement: Leg I. 4.64 (1.1, 0.47, 1.07, 1, 1), Leg II. 4.3 (1.1, 0.35, 1.05, 1, 0.8), Leg III. 2.42 (0.6, 0.3, 0.52, 0.5, 0.5), Leg IV 2.54 (0.8, 0.2, 0.54, 0.5, 0.5).

Distribution

Pakistan **[1]**. Recorded for the first time from Dir Lower (Fig. 8).

Remarks

The species was early reported from Punjab Pakistan in 2008 **[17]** now reported for the 1st time from study area.

Figure 8. Thomasidae, *Thomisus zaheeri* (Parveen, Khan, Mushtaq, Ahmad & Rana, 2008), both male and female

8. *Crossopriza lyoni* Simon, 1893

Material Studied

Nagri Payeen, 1♀ 1♂, 25.vii.2018.

Measurement

BL 6, CL 3.0, CW 2.09, AL 2.5, AW 2.3 Eyes size: AME 0.15, ALE 0.4, PME 0.3, PLE 0.59. Eyes interdistance: AME-AME. 0.2, AME-ALE.0.22, AME-PME.0.35, PME-PME. 0.35. Legs measurement: Leg I. (15.1, 9.47, 4.07, 10, 2.2), Leg II. (11.5, 7.51, 4.15, 10.1, 3.08), Leg III (11.6, 8.3, 3.52, 7.5, 3.15), Leg IV (10.38, 5.92, 4.54, 10.5, 2.5).

Habitat

They are also known as cellar spiders. They live inside human structures mostly under the roof. They catch insects in their web and are insectivores. They are non toxic spiders.

Distribution

Africa. Introduced to USA, Venezuela, Germany, China, Japan, Korea, tropical Asia, Australia and now reported from Pakistan **[1]**.

Remarks

The present study reported this species for the 1st time from Pakistan there was no

record of the species earlier from the country (Fig. 9).

Figure 9. **Pholicid spider, *Crossopriza lyoni* (Simon, 1893), female with eggs**

Discussion

The present study was conducted in Dir Lower. Spiders were collected from different areas and were identified by using stereomicroscope. Collection was done from April 2018 to December 2019. In a previous study 8 families, 13 genera and 18 species were recorded by Arshad *et al*. **[18]** from district Peshawar. Another study that was done at Pir Baba, district Buner Khyber Pakhtunkhwa Pakistan ten families of spiders were identified with Pholicidae the most dominant and Sparassidae the scarce one **[19]**. While in present study 27 families 58 genera and 8 species were studied. All the specimens are not identified to specie level yet, but some were identified and described above. Nearly 19 families were identified more in present study from **[20]**. Present study also ranks high in 17 families from the study done at Pir Baba. Dominant family in present study was Salticidae while family with less species studied was Dipluridae. There is a difference in the diversity of both areas which may be due to climate change or due to difference in collection methods. In another study **[21]** entitled "the biodiversity and predatory efficacy of the spiders in rice field in central Punjab Pakistan" a total of 44 species of spider were recorded from 28000 collected specimens. Which show different biodiversity than that of present study.

Also 23 species, 17 genera and 9 families were recorded from FR Peshawar in a total of 107 collected specimens **[22]**. Present study was comprehensive study and more than 1500 specimens were collected and all were (except some) identified to family level. A total of 18 families more in number were identified than the study of **[22]**. Study by **[4]** identified 132 species, 73 genera in 24 families from 16 districts of Sindh. Another study **[23]** described 104 species and 51 genera under 17 families from Punjab. Sixty six Species, of 32 genera and 10 families were reported by **[24]** from the area of Cholistan and neighboring areas from 3007 specimens. Another study at Shorkot, district Jhang, Punjab, Pakistan reveal 66 species, 34 genera and 12 families in 545 specimens **[2]**. The spider fauna recorded in the present study is somewhat different (27 families were identified in

present study) from study done at Peshawar and FATA, KPK **[22]**, Sindh **[4]** Cholistan Desert **[24]** and district Jhang, Punjab **[2]**. It is because the habitat, biodiversity and climate of the areas mentioned in their studies are different from the present area.

A survey was done at district Gujranwala by **[3]** on spiders. They collected 178 samples. Out of which 22 species, 10 genera in 7 families were recorded with Lycosidae the most abundant family[3]. Tahir and coworkers in 2006-2007 collected 1098 specimens from citrus field. The samples constitute 38 species, 22 genera with 9 families **[25]**. Foliage and ground spider fauna was reported from province of Punjab in twenty one districts of one federal territory and forty three locations. Out of 14743 specimens 157 species and 58 genera were recorded in 21 families **[26]**. A study that was done in Turkey by **[27]** identified 45 spider species from twenty one families in all horticultural orchards. In present study 27 families, 58 genera and 08species were identified. Recorded number of genera and families are more in present study as compare to **[3, 25, 27]** while number of genera in study of **[4]** was greater than present study it is because there are many families with species are not identified yet to genus and specie level. The difference in these studies might be due to climate change, biodiversity and habitat change.

Conclusion

Present study done at Dir Lower concluded six families of the Order Araneae including Salticidae, Araneidae, Sparassidae, Scytodidae, Erisidae, Thomisidae. A total of seven genera (*Plexippus, Hasarius, Araneus, Olios, Scytodes, Stegodyphus and Thomisus)* and eight species (*Plexippus paykulli, Hasarius adonsoni, Araneus mitificus, Olios stimulator, Scytodes thoracica, Stegodyphus sarasinorum, Thomisus zaheeri,Crossopriza lyoni*) were identified and reported out of the six families. Most of the species are recorded for the first time from the area while *Hasarius adonsoni, Olios stimulator, Stegodyphus sarasinorum and Scytodes thoracica* are recorded for the 1st time from Pakistan.

Authors' contributions

Collection: M Sajid, W Murad & M Kamil, Conceived and designed the experiments: M Sajid & M Zahid, Performed the experiment: M Sajid, A Butt & M Rasool, Analysed the Data: M Shah & R Ahmad, Contributed reagents materials/ analysis tools: W Murad, M Kamil & M Ullah, Wrote the Paper: M Sajid.

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