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Research Article

Fruit fly and their management by IPM techniques in Balochistan

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Citation

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Abstract

Current study was carried out based on the management of fruit fly by IPM techniques in the field of Quetta Balochistan. The experiment included the following IPM treatments (sanitation + Methyl-Eugenol, no sanitation + Methyl-Eugenol, sanitation + proteolysis bait, no sanitation + proteolysis bait, Neem extract + Methyl-Eugenol and Neem extract + proteolysis bait. Two test plots were chosen one with sanitation and the other one without sanitation. In each plot, five traps were set. Data was collected for a fortnight until fruit harvesting ended. In present investigation to control pest population of fruit fly we used different fruit fly trap in different methods. A maximum peach population of male fruit fly was observed in methyl eugenol plus 5 % malathion in without sanitation field orchard (660.30±4.31), while similar results also were noticed in female fruit fly population by protein hydrolysate plus 10 % deltamethrin in without sanitation field orchard (540.5±2.73). However, a minimum peach population of male fruit fly was observed in methy eugenol plus 5 % malathion in sanitation field orchard (462.46±1.71).

Keyword: Fruit fly; Management; IPM; Techniques

Introduction

Peach fruit belongs to genus: *persica* and its scientific name is *Persicadominica.* According to Espana **[1]**, peaches are said to have originated in Central American rain forests, most likely in Mexico, and produce fruit twice a year. Since then, it has been cultivated throughout the tropical belt, with India, Sri Lanka, Indonesia, and Malaysia with consideration as a significant commercial crop. Peach is another popular subtropical fruit that matches apples, almonds, etc. It is composed of monosaccharaides such as fructose and sucrose, and has a soft texture and is easy to digest. Peach is a sweet fruit crop used in the commercial production of chewing gum in tropical and subtropical regions. Peach consumption is suggested in herbal medicine due to its numerous therapeutic properties.

The ripe fruits are also used to make jams in Pakistan, because these are considered as a good supply of raw material for the production of industrial pectin, glucose, and natural fruit jellies. They're also available as slices in the can. According to Singh [2], peaches are a tropical and subtropical fruit native to Pakistan and can be grown anywhere up to 1600-2000 meters above sea level. Depending on the soil and climatic conditions, this crop is planted in areas of Balochistan (Loralai Kanmahtorzai Mastung and Pishin) and is particularly suitable for planting (Jagirdar and Bhatti, 1968). Insect pests and diseases have resulted in significant quantity and quality losses. Twig borer, scale, mealy bug, aphid, and fruit fly larvae are among the insect pest larvae. Fruit flies (Diptera: Tephritidae) cause the majority of the damage to peach fruit.Fruit demand has risen in a number of industrialised and developing nations. Every individual demands fresh and healthy nutritious fruit at all times in Pakistan, Drosophila has become the most important pest due to its importance of quarantine. Different pest species attack delicious fruits, but fruit flies (*Tephritidae*, *Diptera*) cause greater economic losses to fruits in Pakistan. There are more than 4000 species in the Diptera Tephritidae [3]. Many developing and developed countries have increased demand for fruits, especially fresh fruits or canned. Per capita fruit consumption has increased from 40 grams to 85 grams, and there is an increasing demand for improving fruit yield and quality. According to Pakistan Ministry of Food and Security Research, Islamabad (2016), Pea minor fruitvated as minor fruit in Pakistan. In 2014-2015, total area under the cultivation of Peach fruit was 1737 ha and total production was 6677 tonnes. This fruit is cultivated only in two Provinces of Pakistan.

Peach fruit fly *Bactrocera zonata* (*B. zonata*) is another serious pest of various fruits. It is found in large numbers in all climatic regions of Pakistan, causing the loss of 3% to 100% of different fruits [4]. The fruit fly is playing an important role as horticultural pest in Pakistan but *B. zonata* is considered as thoughtful or serious pest of many fruits like mango, Chikoo and other citrus fruits. There is 50-55% estimated damage was observed to the citrus fruit orchards due to fruit flies in Pakistan. Since 1962, the *Bactrocera sp.* was a major issue to damage fruits and vegetables in Pakistan and other areas probably. The direct damage of fruit flies without any precaution and control was estimated about 30-80% to fruits and vegetation. The fruit fly damaging percentage differs due to the type of vegetation, location and the growing season of the fruits and vegetables [5].

On the other hand, pests and diseases have an impact on the quality and quantity of fruits. The insect pests include the larvae of fruit flies and twig borer, mealy bug, fruit borer and aphid etc. The most harmful insect pest (fruit flies) of vegetables and fruits belong to family 'Tephritidae' (Diptera). According to current researches 4000 species of fruit flies were reported, out of which 700 species found throughout the world [6]. 440 species of genus Bactrocera were found in most tropical areas of Australia, Asia and South Pacific and some of them could also be found in the African areas. These pests are also known as "orchard flies" because they are closely related to fruits and cause greater economic losses. The adult fruit flies mostly can live about 3 months and during this short life period lay up to one thousand eggs [6]. About 250 of these fruit flies are widely distributed in most tropical and temperate regions of the world. Among them, *Bactrocera dorsalis* [7] and *B. zonata* (Saunders) are serious pests that harm mangoes, guava, cherries, citrus, cypress, peach and other fruits and several cucurbit vegetables.

When female fruit flies lay their eggs within the fruit, the born maggots feed on the pulp,

rendering it unsuitable for human consumption. Fruit begins to decay at the puncture spot. The losses incurred as a result of various fruit fly species. According to scientific literature, the oriental fruit fly (B. dorsalis) is a severe pest that causes 5–100% fruit loss [8]. Kafi [9] reported the highest loss of guava fruit of 80%. Guava fruit flies (*B. Correcta*) are serious pests of guava and various other fruits. Steets [10] reported that guava and peach fruit flies cause 60% to 80% of losses.

Females lay eggs in the fruit, and their maggots feed on the pulp, making them unsuitable for human consumption. Guava fruit fly *B. Correcta* is a serious fruit pest, causing 60-80% loss of guava fruit [10]. Management of fruit flies is a great problem as the maggots feed inside the fruits beyond the reach of insecticides. Moreover, due to its good flying capacity, farm level efforts do not provide much control. The recommendations of poisoned baits were given by various workers and proved effective to some extent, but has become unusable because of residue restriction. Fruit flies pose a major threat to global trade, since many countries like United States, Japan and Australia have invoked quarantine restrictions to minimize the threat of introduction and infestation of unusual species, which pose more serious threats on fruits. Therefore, many countries emphasize on following strict quarantine measures rather than cure by preventing the entry of fruit flies in their country. Fruit fly infestation is probably a major obstacle for the free movement and trade of fruits across the border. Successive cultivation and export of fruits are highly dependent on sound fruit fly control programs. The current and future needs of production and nutrition security can be improved in a sustainable manner without harming the environment. There is a crucial want to adopt economical and friendly technologies to increase the productivity of fruits and vegetables. Production of pesticide-free food and exportable horticultural crops should actively be pursued to meet the demands of the World Trade Organization (WTO).

Materials and Methods

The experiment was carried out at Quetta with three block in RCBD design with following treatments

Treatments

1. Methyl eugenol traps with Sanitation
2. Methyl eugenol without Sanitation.
3. Protein hydrolysate baits with Sanitation
4. Protein hydrolysate baits without Sanitation
5. Methyl eugenol with Neem seed water extract
6. Protein hydrolysate baits with Neem seed water extract

Male methyl eugenol and 5% malathion and female protein hydrolysate baits mixed with 10 % deltamethrin with Sanitation

To determine the pest population of fruits fly, traps having methyl eugenol and Protein hydrolysate baits were used for catching male and female fruit flies. Before using traps treatments block was sanitized, such dropping as droping fruits ware removed from the blocks and the traps was used. One trap was installed in each block three traps were used in each treatment. Small piece of cotton was soaked in the mixture of methyl eugenol and 5% Malathion and Protein hydrolysate baits mixed with 10 % deltamethrin which was placed inside the trap. The traps were hanged on the branches of trees at 4.5 feet height from the ground for 24 hours. The trapped male and female fruit flies were brought in the laboratory for counting the number of trapped fruit flies per trap. Data of pest population was noticed interval August to October.

Male methyl eugenol with 5% malathion and female protein hydrolysate baits mixed with 10 % deltamethrin without Sanitation

To determine the pest population of fruits fly, traps having methyl eugenol and Protein hydrolysate baits were used for catching male and female fruit flies. Block Traps were used dropping as droping fruits from trees and then traps was traps used without sanitation. One trap was installed in each block three traps were used in each treatment. Small piece of cotton was soaked in the mixture of methyl eugenol and 5% Malathion and Protein hydrolysate baits mixed with 10 % deltamethrin which was placed inside the trap. The traps were hanged on the branches of trees at 4.5 feet height from the ground for 24 hours. The trapped male and female fruit flies were brought in the laboratory for counting the number of trapped fruit flies per trap. Data of pest population was noticed interval August to October.

Need seed water extract plus male methyl eugenol with 5% malathion and female protein hydrolysate baits mixed with 10 % deltamethrin

Before using Male Methyl eugenol with 5% Malathion and Female Protein hydrolysate baits mixed with 10 % deltamethrin for controlling fruit fly Neem seed water spray was used on peeh fruit trees in selected experimental block. After neem seed water spray traped was used. One trap was installed in each block three traps were used in each treatment. Small piece of cotton was soaked in the mixture of methyl eugenol and 5% Malathion and Protein hydrolysate baits mixed with 10 % deltamethrin which was placed inside the trap. The traps were hanged on the branches of trees at 4.5 feet height from the ground for 24 hours. The trapped male and female fruit flies were brought in the laboratory for counting the number of trapped fruit flies per trap. Data of pest population was noticed interval August to October.

Statistical analysis

The data collected was subjected to one way Annova using SPSS and Least Significant Difference (LSD) test was applied at 5% probability level to differentiate the entire treatment means.

Results and Discussion

A peak pest population of fruit fly was observed in 30th September (932.70±2.26), followed by 15th September (821.66±2.32), 30th August (638.33±7.20), 15th August (576.50±3.72) and 15th October (462.46±1.71). While a minimum pest population of fruit fly were noticed in 30th October (386.60±3.76). A statistically significant difference was observed among all interthemonthstes of months (Table 1).

Results (Table 2) Furthermore, on September 30th, Bactrocerazonata population was considerably greater in the absence of Sanitation + Methyl-Eugenol than in the presence of Sanitation + Methyl-Eugenol.

Results (Table 3) indicate that the population on the 15th august which is 416.4 and significantly increased.

The results (Table 4) showed that on August 15, the *B. zonata* population captured by without sanitary conditions + proteolysis bait was 629.3±3.24 flies/trap which was further increased up to 752.6±2.82 and 972.5±3.16 flies on 30th September.

Different alphabets among the mean values shows significant difference at <0.05 probability level.

Results (Table 5) indicate that on 15th August the population of *B. zonata* trapped by Neem Extract + Methyl-Eugenol was 749.8±6.4 flies/trap which was further increased up to 813.6±4.4 and 1019.6±5.3 flies/trap on 30th August and 15th September and the population reached at peak level of 1187.6±3.0 flies/trap on 30th September, afterwards the population linearly dropped and reached at 679.8±5. And 563.4±2.7

flies/trap on 15th October and 30th October, respectively. According to statistical analysis, the population of *B. zonata* captured by Neem Extract + Methyl-Eugenol at all fortnight observations was very significant.

Results (Table 6) indicate that the population of *B. zonata* trapped by Neem Extract + Protein hydrolysis baits was 593.2±5.3 flies/trap on 15th August which was further increased up to 657.3±3.74 and 845.6±4.52 flies/trap on 30th August and 15th September and the population reached at peak level of 959.8±3.50 flies/trap on 30th September, afterwards the population linearly dropped and reached at 475.6±3.21 and 398.2±2.9 flies/trap on 15th October and 30th October.

The results (Table 7) show that the largest population of *B. zonata* (835.63±6.67 flies/trap) was trapped under neem seed water extract plus Male Methyl eugenol with 5% Malathion followed by male mean population (Methyl eugenol and 5% Malathion) without sanitation (811.62±7.47 flies/trap), Female mean population protein hydrolysate baits mixed with 10 % deltamethrin without Sanitation (729.16±8.05 flies/trap), neem seed water extract female protein hydrolysate baits mixed with 10 % deltamethrin) (654.96±4.19 flies/trap), male mean population (Methyl eugenol and 5% Malathion) with sanitation (636.36±5 flies/trap), female mean population protein hydrolysate baits mixed with 10 % deltamethrin with sanitation (451.23±4.25 flies/trap). The minimal population of *B. zonata* caught under several IPM treatments followed a similar pattern. In all fortnight observations, analysis of variance (ANOVA) revealed a very significant difference (p0.05) in a population of *B. zonata* caught under different IPM treatments.

Table 1: **Mean population of *Bactrocera zonata* trapped by methyl eugenol and 5% Malathion with sanitation**

Date	Mean population (Methyl eugenol and 5% malathion with sanitation)
15th August	576.50±3.72d
30th August	638.33±7.20c
15th September	821.66±2.32b
30th September	932.70±2.26a
15th October	462.46±1.71e
30th October	386.60±3.76f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 2: Mean population of *Bactrocera zonata* trapped by methyleugenol without sanitation

Date	Mean population Methyl eugenol and 5% Malathion) without Sanitation
15th August	728.23±4.55d
30th August	790.30±3.75c
15th September	990.60±4.10b
30th September	1153.70±2.84a
15th October	660.30±4.31e
30th October	546.6±5.06f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 3: Mean population of *Bactrocera zonata* trapped by protein hydrolysis baits with sanitation

Date	Mean population (Sanitation + Protein hydrolysis baits)
15th August	416.4±3.55d
30th August	476.5±5.10c
15th September	558.7±3.56b
30th September	724.6±4.59a
15th October	298.6±2.76e
30th October	232.6±3.37f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 4: Mean population of *Bactrocera zonata* trapped by protein hydrolysis baits without sanitation

Date	Mean population (Without sanitation+ Protein hydrolysis baits)
15th August	629.3±3.24d
30th August	752.6±2.82c
15th September	972.5±3.16b
30th September	1064.3±3.40a
15th October	540.5±2.73e
30th October	415.8±3.56f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 5: Mean population of *Bactrocera zonata* trapped by neem extract+methyl-eugenol

Date	Mean population (Neem Extract + Methyl-Eugenol)
15th August	749.8±6.4d
30th August	813.6±4.4c
15th September	1019.6±5.3b
30th September	1187.6±3.0a
15th October	679.8±5.9e
30th October	563.4±2.7f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 6: Mean population of *Bactrocera zonata* trapped by neem extract + protein hydrolysis baits

Date	Mean (Neem Extract + Protein hydrolysis baits)
15th August	593.2±5.34d
30th August	657±3.74c
15th September	845.6±4.52b
30th September	959.8±3.50a
15th October	475.6±3.21e
30th October	398.2±5.9f

Different alphabets among the mean values shows significant difference at <0.05 probability level

Table 7: Comparative (Mean) Population of *Bactrocera zonata* trapped under different IPM treatments

Date	Male Mean population (Methyl eugenol and 5% Malathion with sanitation)	Male Mean population (Methyl eugenol and 5% Malathion without sanitation	Female Mean population (Protein hydrolysate baits mixed with 10 % deltamethrin) with Sanitation	Female Mean population (Protein hydrolysate baits mixed with 10 % deltamethrin) without Sanitation	Mean population Neem seed water extract plus mal methyl eugenol with 5% Malathion	Mean population Neem seed water extract female Protein hydrolysate baits mixed with 10 % deltamethrin
15th August	576.50±3.72d	728.23±4.55d	416.4±3.55d	629.3±3.24d	749.8±6.4d	593.2±5.34d
30th August	638.33±7.20c	790.30±3.75c	476.5±5.10c	752.6±2.82c	813.6±4.4c	657.4±3.74c
15th September	821.66±2.32b	990.60±4.10b	558.7±3.56b	972.5±3.16b	1019.6±5.3b	845.6±4.52b
30th September	932.70±2.26a	1153.70±2.84a	724.6±4.59a	1064.3±3.40a	1187.6±3.0a	959.8±3.50a
15th October	462.46±1.71e	660.30±4.31e	298.6±2.76e	540.5±2.73e	679.8±5.9e	475.6±3.21e
30th October	386.60±3.76f	546.6±5.06f	232.6±3.37f	415.8±3.56f	563.4±2.7f	398.2±5.9f
Overall mean population	636.36±5.16e	811.62±7.47b	451.23±4.25f	729.16±8.05c	835.63±6.67a	654.96±4.19d

Discussion

The results of this study show that *methyl eugenol plus neem extrat is highly attracted for the flies*. Our study results are consistent with those of Chen *et al*. [11] determined the effect of neem seed kernel extract on ovi-position of *Drosophila orientalis*. In addition, results also related to Singh [12], who reported that neem seed kernel extract is effective on the fecundity of fruit flies when fed as a water source. The results showed that among 15-day-old fruit flies, the lowest number of cucurbitaceous plants was 15.3 eggs, which was 1.00 ppm, while the highest number recorded was 0.125 ppm. The number recorded was significantly higher, with 228.7 eggs recorded in the control. Similarly, in the case of *B. dorsalis* in 15-day-old fruit flies, the lowest number of 30.7 eggs was laid at 1.00 ppm, while the highest number recorded was 0.125 ppm. The greatest number was reported from the control group, which was highly significant across all concentrations.

B. zonata reached its peak population abundance towards the end of September, following which the population began to fall until Solangi [13] trap heights of 1 m or 3 m. Under Hyderabad's ecological circumstances, *B. zonata* begins to grow rapidly in May and continues to do so until September, with some fluctuations near Tandojam. *B. dorsalis* began to break out in May and reached a peak in June. The *B. dorsalis* is a mango fruit fly, and the results showed that its population was more closely linked to the mango season than to abiotic variables at Tandojam. This suggests that the population of *B. zonata* is linearly related to temperature, with the highest population reported from May to September, and the lowest population recorded during the months of low temperature in Tandojam. In May, fast development of *B. zonata* was discovered in Upper Sindh (Larkana conditions), and the worrisome population persisted until October. Under high temperature circumstances, the *B. zonata* population was substantially larger and sustained; however, when the temperature dropped, the fruit fly population dropped as well. The *B. dorsalis* began to grow slowly in

May and then quickly grew in population, reaching its peak in September. It was observed that at Mahoota guava farm, Larkana, July to September was the period of high *B. dorsalis* infestation and the population of fruit fly may decline in October [12]. According to Raghu [14] the study of female responses to lures and the behavioural implications of these compounds on male and female insect and the plant may offer light on the chemicals' proximal roles. Traps containing either cue-lure (0.25% malathion + 0.1% cue-lure) or methyl-eugenol (0.25% malathion + 0.1% methyl-eugenol) were shown to be successful in catching fruit flies by Manzar and Srivastava [15]. On the other hand, the height of the trap was influencing significantly in determining the number of insects caught. Except for Sewoosunkur *et al.* [16] traps are more effective for the control of fruit flies. Manzar and Srivastava [15] discovered that 4 pheromone (methyl-eugenol) traps were the most effective in controlling fruit flies with lowest damage of 1.05 percent and 4.15 percent, respectively. *Bactrocera* species populations have been eliminated, according to Alzubaidy [17], utilizing a mix of procedures such as the Male Annihilation Technique, foliar, fruit removal and soil pesticide treatments. After then, intensive monitoring is carried out to ensure that the eradicate on efforts are effective. According to Saafan *et al*. [18], *Bactrocera zonata* populations were greater from May to August than the remaining months of the year. Sewoosunkur *et al.* [16] utilized pheromoenetraeps to collect fruit flies and discovered that *Bactrocera zonata* captures were primarily linked with trap height, and that traps put at specific heights yielded to catch more than those traps installed on the ground. In a similar study, Sewoosunkur *et al.* [16] discovered that the population of the oriental fruit fly *B. dorsalis* was smaller than the population of the peach fruit fly *B. zonata* when the two were monitored using the installation patterns and various trap types. According to Solangi *et al.* [13], the peach fly *B. zonata* may be efficiently managed by using a male annihilation approach and spot spraying to prevent full foundation. In July and August, Anjum *et al.* [19] discovered that 4 pheromone (methyl-eugenol) traps were the most effective in controlling fruit flies with minimum damage of 1.5 percent and 4.15 percent, respectively. Seasonal fluctuations of fruit flies (*B. dorsalis* and *B. zonata*) on guava were examined by Dale and Patel [20]. (Cultivars Reshmadi and Lucknow-49). In a guava orchard, five Patel fruit fly traps baited with methyl-eugenol were placed. In the guava orchard, the largest number of fruit fly populations were recorded in September and the lowest in May. The highest fly population occurred during the guava fruiting season. *B. zonata* males gathered the most fruit flies (3665) compared to just 357 *B. dorsalis* females. The minimum temperature and relative humidity exhibited a strong positive association with the fruit fly population in the guava plantation. The height of the trap was crucial in catching the fruit flies.

According to Saafan *et al*. [18], *B. zonata* populations were greater from May to August than the remaining months of the year. Manzar and Srivastava [15] utilized pheromone traps to collect fruit flies and discovered that *B. zonata* catches were primarily linked with trap height, and that traps put at particular heights yielded more catches than traps installed on the ground. Moreover, Sewoosunkur *et al*. [16] discovered that the population of the oriental fruit fly *B. dorsalis* was smaller than the population of the peach fruit fly *B. zonata* when the two were monitored using various trap types and installation patterns. According to Solangi *et al*. [13] the male annihilation approach and spot spraying have effectively controlled the peach fly *B. zonata* and prevented its full development. Present study strongly recommends this. Current

findings support to Stonehouse *et al*. [6], as fruit fly infestation was determined.

Stonehouse *et al*. [6] showed that fruit fly infestation was 29 percent in unprotected fields and 5 percent in areas where traps were set, confirming the findings of the current study. used methyl eugenol traps and recorded *B. correcta, Bactrocerazonata, B. cucurbitae, and B. dorsalis*. *B. dorsalis* was the most dominant, constituting 88.0% in Dharwad and 69.0% in Kumbapur, followed by *B. zonata* (7.0 and 18.0%) and *B. correcta* (4.0 and 13.0%). In Dharwad, *B. zonata* was recorded throughout the year with peak population (6.0 fruit flies week^{-1} trap^{-1}) during the 44th standard week in 2001 and 9th standard week in 2002. In Kumbapur, the population of *B. zonata* peaked during the 20th standard week in 2001 (13.75 fruit flies week^{-1} trap^{-1}) and 8th standard week in 2002 (10 fruit flies week^{-1} trap^{-1}). The trap height and pattern of installation showed significant effect on the fruit fly catches in guava and mango orchards. In Pakistan investigated the impact of the number and size of holes in traps on *Bactrocera* spp. (*B. correcta, B. zonata, and B. dorsalis*) catching efficiency in mango.

Conclusion

In present investigation to control pest population of fruit fly we used different fruit fly trap in different methods. A maximum peach population of male fruit fly was observed in methy eugenol plus 5 % malathion in without sanitation field orchard, while similar results also were noticed in female fruit fly population by protein hydrolysate plus 10 % deltamethrin in without sanitation field orchard. However, a minimum peach population of male fruit fly was observed in methy eugenol plus 5 % malathion in sanitation field orchard, while similar results also were noticed in female fruit fly population by protein hydrolysate plus 10 % deltamethrin in sanitation field orchard. But when it is compared with need seed water extract mix with methy eugenol plus 5 % malathion the pest population male fruit flies were found higher then sanitation and without sanitation field orchard. Thus, the highest pest population of female fruit flies was noticed on protein hydrolysate plus 10 % deltamethrin trap when it is compared with need seed water extract mixing in protein hydrolysate plus 10 % deltamethrin. It means that pheromones trap has strong potential to reduce the pest population of fruit flies in orchard field. These results are indicating that before using pheromones trap the orchard sanitation is necessary, because damage and falling fruits is also the causes of increasing pest population of peach fruit flies.

Authors' contributions

Conceived and designed the experiments: Bk Solangi, M Khan & GR Bangulzai, Performed the experiments: F Adnan, M Khan, M Amin, A Waris & R Ali, Analyzed the data: A Ghani, M Khan, BK Solangi & NA Shahwani, Contributed materials/ analysis/ tools: GR Bangulzai, H Kakar & M Khan, Wrote the paper: BK Solangi, M Khan &GR Bangulzai.

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