

Feeding Preferences of Red Legged Partridge, *Alectoris chukar* Gray (Galliformes: Phasianidae) on Harmful and Beneficial Insects

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Abstract.- The feeding preferences of red legged partridge (RLP), *Alectoris chukar* Gray (Galliformes: Phasianidae), on wheat kernel (WK), sunn pest (SP) *Eurygaster integriceps* Put. shield bug (SB) *Dolycoris baccarum* L. (Heteroptera: Pentatomidae) and lady bug (LB), *Coccinella septempunctata* L. have been investigated under laboratory condition. Foods were given in to the partridges for one hour plastic cases firstly periodically (SP + SB, SP + LB, SP + WK, SB + LB, SB + WK and LB + WK) then ternary (SP + SB + LB, SP + SB + WK, SP + LB + WK and SB + LB + WK) and lastly quadruplet (SP + SB + LB + WK). According to the obtained data, it was found that the RLPs feed on WK, SP and SB, and although they feed on LB, the preference was very low. The RLP preferred wheat more than SP and SB.

Key words: *Alectoris chukar*, *Eurygaster integriceps*, *Dolycoris baccarum*, *Coccinella septempunctata*, wheat kernel

INTRODUCTION

Red legged partridge (RLP), *Alectoris chukar* Gray (Galliformes: Phasianidae), takes an important place in our natural life. This species was spread in Greece, Bulgaria, Anatolia, and Southeast from Chine to Manchuria (Del-Hoyo *et al.*, 1994). It was found that of all partridges in Turkey such as rock partridge (*Alectoris graeca* Meister), grey partridge (*Perdix perdix*), sand (desert) partridge (*Ammoperdix griseogularis* Brandt) and caspian snowcock (*Tetraoallus caspius* Gm.) in Turkey, RLP was the most widespread (Kiziroğlu, 1983; Yılmaz and Tepli, 2009). Partridge feed on plenty of insects and harmful weed seed for wheat, barley and oat that is cultivated by human being and in this way they play important role in maintaining the natural balance. Existing in a herd until recently, a number of partridges has recently diminished because of hunting and the chemicals that are sprayed in the agricultural fields (Alkan *et al.*, 2008).

Wheat (WK) is the most widely grown crop, due to its adaptability to all kinds of weather. It is the most important nutrition of the human being contains about 20% of all calories provided from the food all over the world (Akaya, 1994).

Sunn pest (SP), *Eurygaster* ssp. (Heteroptera: Scutelleridae) are the most important harmful insects of the wheat, as they feed on the stem of the plants in the early and flowering period as a result the crop is partially or completely destroyed (Lodos, 1961, 1986).

Shield bug (SB), *Dolycoris baccarum* L. (Heteroptera: Pentatomidae) existing commonly in Turkey, a polyphagus harmful insect, feeds on sunflower preeminently, lentil, tobacco, sesame, trifolium, corn, other grains and many wild and cultured plants. It causes damage to the grains by feeding on the kernels mostly in the developing and milky periods. Especially its damage to sesame and sunflower plants is important (Lodos, 1986).

One of the most important biological agents used against harmful insects on the cultured plants in the world and Turkey is the Coccinellidae family members belonging to Coleoptera. Until recently 108 species belonging to this family have been determined in our country (Uygun, 1981). Lady bug (LB), *Coccinella septempunctata* L. (Coleoptera: Coccinellidae) is one of the most important members of this family. Both larvae and adults of this species are the natural enemies of aphids, scale insects, thrips, red mites and many others harmful insects (Uygun, 1981).

Recently RLP have been released to the nature for both touristic purpose of hunting and suppressing some agricultural harmful insects such as SP and keep its population level under economic

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threshold (Kayaöz, 1999; Yardımcı, 2005; Anonymous, 2010). Although the effects of RLP on the harmful and beneficial insects have not been known scientifically, it has still been continued in different regions of Turkey.

In this study, food preference of RLP has been determined among natural food (WK), two important harmful insects (SP and SB), and a beneficial insect (LB) under the laboratory condition. It is thought that obtained data will determine the suitability of releasing RLP and lighten the prudential biological pest management studies in future.

MATERIALS AND METHODS

The main materials of this study comprised 4 a year old RLP *E. integriceps*, *D. baccarum* and *C. septempunctata* provided by the Ministry of Environment and Forest, Partridge Breeding Station, brought in the ice containers from the overwintering areas on Nemrut Mountain in Adıyaman (37° 58' N 38° 44' E) and grain of Adana 99 wheat variety.

To determine the preference of RLP, 50 birds they were kept hungry for 12 h in the cages (sized 1 x 1 x 0.5 m), WKs, SPs, SBs, and LBs were given to partridges as 2, 3 and 4 in a group. Water was given *ad libitum* in the 0.5 L pots. To limit the movement abilities of SP, SB and LB, at -21°C. Feeds were given firstly as binary groups (SP + SB - SP + LB, SP + WK, SB + LB, SB + WK and LB + WK), after that ternary groups (SP + SB + LB - SP + WK + SB, SP + LB + WK, and SB + LB + WK), and at last tetra groups (SP + SB + LB + WK). After giving the feed, RLP were monitored every 15 min. until one hour and the food consumed was recorded. Thus, total food amount consumed by RLP in one hour was determined.

The data was analyzed by using SPSS statistics program. Food consumption was evaluated using T - test and the time taken for consumption were evaluated by using variance analysis (one way ANOVA). In ternary and tetra groups, the interactions between the consumed food kinds and consuming durations were determined by using two-ways variance analysis (two way ANOVA).

RESULTS AND DISCUSSION

Double food items

Table I shows the number of food items consumed in binary group (SP + SB - SP + LB, SP + WK, SB + LB, SB + WK and LB + WK). It was found that in WK + LB group 56 food items were consumed and 89% of this was WK (50 kernels) and 11% was LB (6 LBs) during the first 15 min, while consuming wheat amount was 80% (40 pieces), but there was no LB consumption during 15-30 min, on the average 8 WK were consumed; the remaining 2 WK were seen to be consumed during 30-45 min. The LB consumption (the average 5 LB) also started when WK was at the minimum level. Only one LB was consumed during 45-60 min.

Table I.- Number of food items consumed by *Alectoris chukar* in double group (Average ± SE).

Foods	Number of food items consumed (Average ±SE)	
	I. Species	II. Species
WK + LB	12.50±4.21 a	1.50±0.56 b
SP + LB	12.50±4.20 a	1.43±0.56 b
WK + SP	12.50±4.86 a	12.50±2.38 a
SP + SB	12.50±3.68 a	12.50±4.21 a
WK + SB	12.50±4.48 a	12.50±2.33 a
SB + LB	12.50±3.28 a	1.25±0.38 b

WK, wheat kernel; SP, Sunn pest; SB, shield bug; LB, lady bug. Mean differences with different letters within the same row are statistically significant (P<0.05)

In the food group of SP + LB, in the first 15 min 32 SP (64%) and in the second 15 min 13 SP were observed to be consumed. No LB was consumed. In the third 15 min, it was found that 5 SP and 4 LB (totally 9 individuals) were observed to be consumed. In the following 15 min only two LB were observed to be consumed.

In the food group of WK + SB, the number of consumed food in the first 15 min 42 WK (84%), 26 SB (52%), 7 WK, 14 SB in the second time slice, and 1 WK, 5 SB in the third time slice were observed to be consumed (Table I).

In the SP + SB binary food group, 40 SB (72%) and 36 SP (80%) were consumed in the first 15 min. Totally 18 pieces (8 SB and 10 SP) were consumed in 15-30 min and 2 SB and 4 SP were

observed to be consumed during 30-45 min.

In the food group of WK + SP in the first 15 min 45 WK (90%) and 25 SP (50%) were consumed. During 15-30 seconds, 4 WK and 11 SP were consumed, and in the third time slice 1 WK and 14 SP were consumed.

In the last group food group of SB + LB, 34 SB (68%) were consumed. No LB was consumed, while 6 SB and 1 LB were consumed during 15-30 min, 6 SB and 3 LB during 30-45 min and during 45-60 min, 4 SB and only 1 LB were consumed.

At the statistical analysis applied to the binary food groups, it was determined that there were differences statistically in terms of consumed food among the groups of WK + LB (t-test: $t_{30} = 27.264$, $P = 0.15$), SP + LB (t-test: $t_{30} = 30.513$, $P = 0.02$) and SB + LB (t-test: $t_{30} = 6.882$, $P = 0.14$), were found statistically significant. However, the differences among the groups of WK + SP (t-test: $t_{30} = 9.808$, $P = 0.745$), SP + SB (t-test: $t_{30} = 0.342$, $P = 0.812$) and WK + SB (t-test: $t_{30} = 6.882$, $P = 0.775$) were not found statistically significant.

The consumed food item numbers of RLP during 0-15, 15-30, 30-45, and 45-60 min were found statistically significant in the groups of WK + LB ($F_{3,28} = 39.466$, $P = 0.000$), SP + LB ($F_{3,28} = 4.106$, $P = 0.016$), WK + SP ($F_{3,28} = 39.466$, $P = 0.000$), SP + SB ($F_{3,28} = 26.511$, $P = 0.000$), WK + SB ($F_{3,28} = 39.466$, $P = 0.000$), SB + LB ($F_{3,28} = 39.466$, $P = 0.000$). WK, SP and SB were firstly consumed between 0-15 and 15-30 min, but LB consumption occurred during the 30-45 min in which WK, SP and SB were finished or too few according to the other foods (Table II).

Triple food times

The amount of consumed food by RLP in the groups of SP + SB + LB, WK + SP + SB, WK + SP + LB and WK + SB + LB are given in Table III.

In the SP + SB + LB ternary food group, the highest consuming numbers of RLP were 35 SP (70%), and this was followed by SB with 21 individuals (42%) and the last one was determined to be LB with the rate of 2% during 0-15 min. It was determined that 12 SP, 9 SB, 1 LB were consumed during 15-30 min and the number of SP decreased considerably during 30-45 min, remaining 3 SP, 16 SB and 5 LB were observed to be consumed. At the

Table II.- Numbers of food consumption of *Alectoris chukar* in double groups at different time periods (Average ±SE).

Food	Time (I. Species)				Time (II. Species)			
	0-15	15-30	30-45	45-60	0-15	15-30	30-45	45-60
WK + LB	40.00±2.12a	8.00±1.08 b	2.00±1.15 d	0.00±0.00 d	0.00±0.00 d	0.00±0.00 d	5.00±0.70 c	0.75±0.25 d
SP + LB	32.00±2.34a	13.00±2.12 b	5.00±0.57 c	0.00±0.00 d	0.00±0.00 d	0.00±0.00 d	4.00±0.91 c	2.00±0.40 d
WK + SP	45.00±0.70a	4.00±0.81 d	1.00±0.40 de	0.00±0.00 e	25.00±2.12 b	11.00±1.29 c	14.00±1.35c	0.00±0.00 e
SP + SB	36.00±1.87a	10.00±1.95 b	4.00±1.41 cd	0.00±0.00 d	40.00±1.82 a	8.00±1.95 bc	2.00±0.91 d	0.00±0.00 d
WK + SB	42.00±1.87a	7.00±1.47 d	1.00±0.57 ef	0.00±0.00 f	26.00±2.45 b	14.00±1.47 c	5.00±0.91 de	5.00±0.70 de
SB + LB	34.00±1.82a	6.00±1.29 b	6.00±1.08 b	4.00±1.68 bc	0.00±0.00 e	1.00±0.57 de	3.00±0.70 bc	1.00±0.70 de

WK, wheat kernel; SP, Sunn pest; SB, shield bug; LB, lady bug.

Mean differences with different letters within the same row are statistically significant ($P < 0.05$)

last time interval 4 SB and 6 LB were consumed. Table III likewise shows consumption of different items administered in combination of three during the first, second, third and four 15 min.

Statistical analysis results applied to the food consumption of RLP in the groups of SP + SB + LB, WK + SP + SB, WK + SB + LB, WK + SP + LB without considering the time factor are given at Table IV. The number of food items consumed in the group WK + SP + SB ($F_{2,45} = 9.345$, $P = 0.082$) were not found significant statistically and they took place in the same group. In the groups of SP + SB + LB ($F_{2,45} = 5.635$, $P = 0.007$), WK + SB + LB ($F_{2,45} = 3.299$, $P = 0.46$) and WK + SP + LB ($F_{2,45} = 3.349$, $P = 0.044$), the differences among the food numbers were found significant statistically, while SP and SB took place in the same group but LB took place in a different group.

The interactions between food amounts in all food groups and the time factor were found significant SP + SB + LB ($F_{2,6} = 45.884$, $P = 0.000$), WK + SP + SB ($F_{2,6} = 58.576$, $P = 0.038$), WK + SB + LB ($F_{2,6} = 87.502$, $P = 0.000$), WK + SP + LB ($F_{2,6} = 14.007$, $P = 0.000$). It was determined that RLP feed on the SP the most and in the shortest time in the group of SP + SB + LB turned to the SB in the case of diminishing or completely exhausting of SP, turned to the LB in the case of diminishing or completely exhausting of SB, but it was observed that feeding on the LB was very limited (Table III). Although the highest and the fastest food consuming occurred on the WK in the food group of WK + SP + SB consuming SP and SB was found substantial. As a matter of fact after finishing the WK, RLP consumed SP and SB at the same rate, and it was determined that SP and SB took place in the same group. Examining the consumed food numbers in the food group of WK + SB + LB, it was determined that WK is the food that was consumed in the shortest time, which was followed by SB. The consumption of LB was limited. Statistically grouping the consumed food numbers in the food group of WK + SP + LB, WK and SP took place in the same group, consumed LB took place in another different group. Thus, although the preferences of RLP in this group were WK and SP, it was observed that RLP didn't prefer LB as in other groups (Table IV).

Table III.- Average food consumption of *Alectoris chukar* in triple groups at different time periods (Average \pm SE).

Foods	Time (I. Species)			Time (II. Species)			Time (III. Species)			
	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30-45	45-60
SP + SB + LB	35.0 \pm 2.0a	12.0 \pm 1.9d	3.0 \pm 1.0gh	21.0 \pm 1.8b	9.0 \pm 1.7de	16.0 \pm 1.4c	1.0 \pm 0.7h	1.0 \pm 0.4d	6.0 \pm 1.0ef	3.0 \pm 0.40gh
WK + SP + SB	48.0 \pm 1.2a	2.0 \pm 1.2c	0.0 \pm 0.0c	40.0 \pm 5.8b	8.0 \pm 3.6c	2.0 \pm 0.9c	38.0 \pm 1.4b	6.0 \pm 0.9c	5.0 \pm 1.6c	1.0 \pm 0.7c
WK + SB + LB	43.0 \pm 2.5a	7.0 \pm 1.5d	0.0 \pm 0.0e	35.0 \pm 1.0b	13.0 \pm 1.0c	2.0 \pm 0.9e	1.0 \pm 0.4e	2.0 \pm 0.7e	1.0 \pm 0.5e	4.0 \pm 0.4de
WK + SP + LB	40.0 \pm 4.8a	8.0 \pm 2.9 b	4.0 \pm 2.3b	38.0 \pm 6.0a	9.0 \pm 4.1b	3.0 \pm 2.3b	1.0 \pm 0.3b	1.0 \pm 0.4b	2.0 \pm 0.5b	3.0 \pm 0.7b

For Abbreviations used and statistical analysis see footnote of Table II.

Table IV.- Food consumptions of *Alectoris chukar* in groups of three items (Average ±SE).

Foods	Number of food items consumed (Average ±SE)		
	I. Species	II. Species	III. Species
SP + SB + LB	12.50±3.60 a	12.50±1.86 a	2.75±0.61 b
WK + SP + SB	12.50±5.31 a	12.50±4.51 a	12.50±3.87 a
WK + SB + LB	12.50±4.67 a	12.50±3.61 a	2.00±0.34 b
WK + SP + LB	12.50±4.38 a	12.50±4.25 a	1.75±0.94 b

For abbreviations see footnote of Table I.

Tetra food items

Table V shows consumption of food items offered in tetra. When examined, at the interval 0-15 min it was found that all of WKS, 49 SP and 46 SB were consumed. No LB was consumed. At 15-30 min interval, there was no wheat consumption because none was left, and hence 1 SP and 1 SB were consumed at this time interval. At the 30-45 min, wheat, SP and SB was consumed; 3 LB were consumed during 45-60 min consumed, 2 LB, totally 5 LB were consumed.

Table V shows consumption rate of tetra food items offered collectively to *A. chukar* after every 15 min, the interaction between the consumed food items and the times were found statistically significant ($F_{3,9} = 145.373, P = 0.000$). At the statistical grouping, while wheat took place in a different group but SP and SB took place in the same group. LB consumption was very limited.

According to the obtained data it was found that RLP feed on wheat, SP and SB, although feeding on LB, consuming was very low. It was determined that while wheat, natural food of RLP, was more prioritized than SP and SB, LB was less preferred than others. Although parallel study has not been reported in the literature, but it has been reported that with the increasing Zn (Bioplex) added to the rations of RLP in different levels, food consuming levels were not affected, and live weight, live weight increase coefficients and utilization coefficients from the food were effected positively (Yildiz, 2004). Duru *et al.* (2013) determined that, some of plant diet (*Trigonella foenum-graceum L.*) effected on growth performance, body components, digestive parts, and blood parameters of broiler chicks. Cufudar *et al.* (2009) reported that adding amino acid including protein in low levels didn't

Table V.- Average food consumption of *Alectoris chukar* in quadruple group at different time periods (Average ±SE).

Foods	Time (I. Species)			Time (II. Species)			Time (III. Species)			Time (IV. Species)						
	0-15	15-30	30-45	45-60	0-15	15-30	30-45	45-60	0-15	15-30	30-45	45-60	45-60			
WK+SP+SB+LB	48±1.2a	2±1.2d	0±0.0e	0±0.0e	45±1.8b	5±1.8cd	0±0.0e	0±0.0e	43±0.0b	7±0.0c	0±0.0e	0±0.0e	3±1.4de	2±0.0de	0±0.0e	0±0.0e

WK, wheat kernel; SP, sunn pest; SB, shield bug; LB, lady bug.
Mean differences with different letters within the same row are statistically significant (P<0.05)

affect fertility features importantly. Moran (1980), stated that in the study carried out feeding of RLP on the wheat and corn kernels in different colors covered by sodium fluoresced used against rats, RLP didn't feed natural colored wheat and corn kernels, and however they fed green colored kernels mostly.

While SP was a problem only in the Southeast and South Anatolia regions in the years of 1950, recently 75% of the cereals cultivated areas are under the threat of SP (Şimşek, 1998). Chemical management by plane was carried out to decrease SP damage to the acceptable level between 1954 and 2005. Because of the damaging effects of the chemical management applied by plane to the environment and human health, the chemical management has been carried out by ground equipments in Turkey since 2005. However, chemical management carried out by ground equipment both reduced the achievement of the management and the amount of the chemicals, since the necessity of applying in extensive areas in a very limited time and reluctance of the producers. Although this case is satisfactory for the natural balance; it causes losses in the yield unless natural enemies are widespread. As the result of the investigations carried out in the world and in our country, it was determined that in the factors suppressing the SP populations, natural enemies has great important role (Lodos, 1961, 1986; Brown, 1962; Yüksel, 1968; Memişoğlu and Özer, 1994; Rosca *et al.*, 1996; İslamoğlu, 2012). Among them, egg parasitoids (Hymenoptera; Scelionidae) and adult parasitoids (Diptera; Tachinidae) are effective in cultivated areas, predators like partridge and pheasant are effective in both cultivated and winter site (İslamoğlu and Kornoşor, 2003; Lodos 1961, 1986; İslamoğlu *et al.*, 2011). SP and SB become prey to the partridges when wintering under the weed like wild liquorice and Echinacea as being semi or proper diapause and wintered adult numbers are relatively limited. Similarly they lessen wintered adult or nymph numbers by feeding on SP when taking a rest or feeding in cultivated areas. In SP management to provide the natural balance it necessary that natural enemies should be thought as whole and fundamental precautions should be taken to increase the activity of each of them. In this

context it is proposed that planning including biological management should be done by regarding the studies and projects about using partridges (Oğurlu, 2008). Unconscious hunting especially in hatching periods causes to decrease the number of the partridges and the suppressions on SP populations decrease. Recently determining the releasing areas of RLPs mass reared by The Ministry of Environment and City Planning by the Ministry of Food Agriculture and Livestock in the areas where SP is common inspires the conviction of that SP management will reach to the success and RLPs will adapt to the environment. In this regard Ministry of Food, Agriculture and Animal Husbandry or private institutions will do together in partnership will be useful.

As a result, it is thought that releasing RLP programs applied in SP management will help suppressing on *Eurygaster* sp. naturally and the number of RLP will increase in nature.

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