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EVALUATION OF APPLICATION OF THE INTENSIVE RABBIT PRODUCTION SYSTEM UNDER THE SUB-TROPICAL CONDITIONS OF EGYPT

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BSTRACT : The study included 747 litters obtained from 173 New ealand White (NZW) does, during one calendar year. Mating was rried out at the start of the breeding season (October), then on the cond day after kindling. Pregnancy diagnosis was carried out ten ys after service and the empty does were rebred in the same day. e results showed that the highest percentage of litters came from atings carried out within the first ten days after kindling (55.4%), llowed by those mated > 30 days (18.1%), 11 - 20 days (14.7%) d 21 - 30 days (11.9%) after kindling. The effects of open days emating interval) on most of the studied traits were not significant. e average theoretical number of litters/year (classified according to ndling intervals) was 8.7. The study of the litter size showed that 5 - kits was the most frequent size (47.5%), followed by ≥ 8 (28.4%) and ≤ 4 (24.1%) kits/litter. The traits which were significantly (P<0.001) correlated with litter size were milk yield, milk intake and milk conversion ratio, kit's weight at birth and at weaning and kit's weight gain. The highest litter size (≥8) was accompanied by the highest milk yield (148 g/d) and the lowest individual milk intake per day (20.9 g), kit's weight at birth (61.5 g) and at weaning (443 g), kit's weight gain (13.6 g/d) and milk conversion ratio (1.5 g milk/g gain). Average litter size at birth was 6.4. Year season effect showed that the highest percentage of litters was recorded in autumn (32.8%), followed by spring (30.4%), winter (24.4%) and summer (12.4%). The effects of year season on most of the studied traits were significant. Interactions between main factors were not significant on most of the studied traits.

ESUME : Evaluation du système de production intensive du pin dans les conditions subtropicales égyptiennes.
our cette étude qui a duré 1 an, 747 portées issues de 173 femelles éo-Zélandais Blanc ont été utilisées. Les saillies ont débuté au début la saison d'élevage (octobre). Elles ont été effectuées le deuxième ur après la mise bas. Le diagnostic de gestation a été effectué 10 urs après la saillie et les femelles non gestantes ont été re-saillies le ême jour. Les résultats montrent que les plus forts pourcentages de ortées proviennent des saillies effectuées pendant les 10 jours qui ivent la mise bas (55,4%), suivis par les saillies effectuées à plus de) jours (18,1%), entre 11 et 20 jours (14,7%) et entre 21et 30 jours 1,9%) après la mise bas. L'effet de l'intervalle entre 2 saillies n'est as significatif pour la plupart des caractéristiques étudiées. Le ombre théorique moyen de portées par an (calculé d'après les tervalles entre deux saillies) est de 8,7. La taille de portée la plus équente est de 5-7 lapereaux (47,5%), suivie par ≥ 8 lapereaux '8,4%) et ≤ 4 lapereaux (24,1%) par portée. Les caractéristiques significativement (P<0.001) corrélées avec la taille de la portée sont la production laitière, la consommation et l'efficacité laitière, le poids des lapereaux à la naissance et au sevrage et le gain de poids des lapereaux. A la plus grande taille de portée (≥ 8 lapereaux) correspond la plus forte production laitière (148 g/jour) et les plus faibles valeurs de consommation individuelle de lait par jour (20,9 g), de poids des lapereaux à la naissance (61,5 g) et au sevrage (443 g), de gain de poids par lapereaux (13,6 g/j) et d' efficacité laitière (1,5 g de lait/g gain de poids). La taille moyenne de la portée à la naissance est de 6,4 lapereaux. La saison affecte le pourcentage de portées obtenues, les plus forts étant enregistrées en Automne (32,8%), suivis par le printemps (30,4%) l'hiver (24,4%) et l'été (12,4%). Les effets de la saison sont significatifs sur la plupart des paramètres étudiés. L'interaction entre les paramètres principaux n'est pas significative pour la plupart des caractéristiques étudiées.

INTRODUCTION

In developing countries, the immediate necessity r maximising food production favours the use of ıbbits for meat production in advance of all asonable options. However, the local conventional ıbbit production systems are normally extensive and ractised in small hutches. In addition, the duration of ie breeding season is limited to 6 - 7 months each ear, due to the unfavourable conditions of the hot imate season for rabbit production. For instance, iere is not any system that can be applied for high roduction of rabbits in such regions, except the rabbit itensive production system with different sizes.

In the following work, a trial was carried out for ne calendar year, to evaluate application of the itensive production system under the prevailing sub-opical conditions in Egypt. Effects of open days (remating interval), litter size at birth, year season and their interactions on some reproductive and productive performance traits of New Zealand White rabbits, were studied.

MATERIAL AND METHODS

The study was conducted on New Zealand White rabbits breed in the Rabbitry of the Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. The study included 747 litters obtained from 173 does, during one calendar year (1994). Bucks and does were firstly mated at around 23 weeks of age.

Animals were fed *ad libitum* with commercial diet containing approximately 16.3% crude protein, 2.5% crude fat, 14.0% crude fibre and 2480 kcal digestible energy/kg diet. Water was available all time by automatic nipple drinkers. Kits were fed by suckling their mother, in addition to the amount of their mothers commercial diet which they consumed after their third week of age.

The animals were divided into groups of five does and one buck. Mating (two services) was carried out naturally with bucks of proven fertility at the start of the breeding season (October), then on the second day after kindling. Each doe was transferred to buck's cage to be mated, and it was later returned to its cage. Abdominal palpation was employed ten days after service for pregnancy diagnosis and the empty does were rebred in the same day. The same practice was repeated with the repeatedly empty does until pregnancy was achieved for all does. Gestation period was estimated from the day of mating to the day of parturition. Milk yield was estimated every day during the lactation period by the difference in doe weight before and after suckling that occurred once at 8.00 h every day. Milk conversion ratio was calculated by dividing daily milk yield by daily kit weight gain, during the suckling period. Weaning age was 28 days.

Does were housed individually in universal galvanized wire batteries (50 × 55 × 39 cm) that were provided with feeders, automatic drinkers and nest boxes (40 × 32 × 29 cm). The building of rabbits was conventional unheated windowed, naturally ventilated one, provided with electric fans and lighted 14–16 h per day throughout the year. Air temperature averages were 15.3, 24.8, 31.3 and 22.8°C during winter, spring, summer and autumn, respectively, while the corresponding relative humidity values were 81.8, 70.0, 76.4 and 76.8%, respectively, inside the building.

The data of doe performance, i.e. gestation period, litter size and weight and mortality rate (number of kits died) were statistically analysed by 2×2 factorial experiment (SAS, 1990) according to the following model:

$$Y_{ijk} = \mu + D_i + S_j + DS_{ij} + e_{ijk} \quad (1),$$

where

- μ = the overall mean
- D_i = the fixed effect of i^{th} open days class (i = 1...4)
- S_j = the fixed effect of j^{th} season (j = 1...4)
- DS_{ij} = the interaction between the i^{th} open days class and j^{th} season
- e_{ijk} = random error.

The data of milk yield and milk conversion ratio, kit's weight and weight gain were statistically analysed by 2×2×2 factorial experiment according to the following model:

$$Y_{ijkl} = \mu + D_i + L_j + S_k + DL_{ij} + DS_{ik} + LS_{jk} + DLS_{ijk} + e_{ijkl} \quad (2),$$

where

- μ, D_i and S_k as shown in model 1.
- L_j = the fixed effect of j^{th} litter size class (j = 1...3)
- DL_{ij} = the interaction between the i^{th} open days class and j^{th} litter size class
- DS_{ik} = the interaction between the i^{th} open days class and k^{th} season
- LS_{jk} = the interaction between the j^{th} litter size class and k^{th} season
- DLS_{ijk} = the interaction between the i^{th} open days class, j^{th} litter size class and k^{th} season
- e_{ijkl} = random error.

Table 1 : Gestation period, litter size, litter weight and mortality rate as affected by open days, year season and their interaction in New Zealand White rabbits.

Items	Gestation length (Days)	Litter size (kits) Birth	Litter size (kits) Weaning	Litter weight (g) Birth	Litter weight (g) Weaning	Mortality (kits) Birth	Mortality (kits) Weaning
Open days classes							
≤ 10	29.3±0.1	6.1±0.1	4.6±0.1	414.6± 6.2	2120±40	1.88±0.1	0.44±0.1
11 – 20	29.5±0.1	6.3±0.2	4.5±0.2	430.4±10.6	2100±31	2.32±0.2	0.42±0.1
21 – 30	29.5±0.1	6.5±0.3	5.0±0.2	446.1±14.1	2303±84	2.02±0.2	0.53±0.1
> 30	29.6±0.1	6.6±0.2	5.4±0.2	452.2±12.2	2451±74	1.73±0.1	0.44±0.1
Significance	NS	NS	NS	NS	*	NS	NS
Year season							
Winter	29.7±0.1	6.6±0.2	5.3±0.2	450.6±10.1	2423±62	1.65±0.1	0.42±0.1
Spring	29.6±0.1	6.5±0.2	4.8±0.1	431.4± 8.8	2200±56	2.16±0.1	0.48±0.1
Summer	29.2±0.1	5.8±0.2	3.8±0.2	405.4±10.9	1771±85	2.55±0.2	0.57±0.1
Autumn	29.2±0.1	6.1±0.1	4.8±0.1	415.1± 7.9	2192±49	1.69±0.1	0.42±0.1
Significance	NS	**	***	NS	***	***	NS

* P< 0.05, ** P< 0.01, *** P< 0.001 and NS = not significant.; interaction between open days classes and year season did not show any significant effect.

For litter size, the 3 classes were : ≤ 4 ; 5 to 7 ; 8 and more kits. The for open days, classes were : 1 to 10 d. ; 11 to 20 d. ; 21 to 30 days ; and more than 30 days.

RESULTS AND DISCUSSION

The results are presented in Tables 1 and 2. Classification of the data according to classes of open days (Table 1) showed that the highest percentage of litters came from fertile matings carried out during the first ten days after kindling (55.4%), followed by those obtained after more than 30 days *i.e.* after weaning (18.1%), 11–20 (14.7%) and 21–30 (11.9%) after kindling. However, most of the traits were not significantly affected by open days. Only litter size and weight at weaning were significantly (P<0.05) affected (Table 1). The highest values of litter size and weight at weaning were recorded with the longest open days duration. The average theoretical number of litters/year (classified according to kindling intervals) was 8.7, which was nearly similar to that estimated by MARAI (Personal communication) from the work of YAMANI *et al.* (1992 a & b) and TAWFEEK (1995) under the same conditions. Such results favour to practice the intensive production system using NZW rabbits, under the prevailing sub-tropical environmental conditions in Egypt

When classifying the data according to litter size, the most frequent litter size was 5 – 7 (47.5%) kits per litter, followed by ≥ 8 (28.4%) and ≤ 4 (24.1%) kits per litter (Table 2). Within open days classes, the litter size classes were nearly of the same order (Table 2). Litter size affected significantly (P<0.001) milk yield, milk intake and milk conversion ratio, kit weight and weight gain (Table 2). The highest litter size (≥ 8) was accompanied with the highest milk yield (148 g/d) and the lowest values of individual milk intake per day (20.9 g), kit weight at birth (61.5 g) and at weaning (442 g), kit weight gain (13.6 g/d) and milk conversion ratio (1.5 g milk/g kit gain). The contrary was true with the lowest litter size class (≤ 4). These results are logic, since the small number of kits in the latter class will have more chance to obtain more milk and, accordingly, obtain more weight gain. The average number of kits per litter at birth was 6.4, which was higher than that estimated under the same conditions (5.9) by MARAI (Personal communication).

With regard to the year season effect, Table 1 shows that the highest percentage of litters was recorded in autumn (32.4%), followed by spring (30.4%), winter (24.4%) and summer (12.4%). The value recorded during summer was about one third of that of the autumn. This phenomenon in addition to the sanitary problems for the young during summer season, are reasons for that the traditional breeding stops during summer in Egypt. The year season affected significantly litter size at birth (P<0.01) and at weaning (P<0.001), litter weight at weaning (P<0.001), mortality rate at birth (P<0.001), milk yield (P<0.001), milk intake (P<0.001), milk conversion ratio (P<0.01) and kit weight at birth (P<0.05; Tables 1 and 2). Summer season showed the lowest values of litter size at birth (5.8 kits) and at weaning (3.8 kits) and litter weight at birth (405 g) and at weaning (1770 g) and the highest mortality rate at birth (2.55 kits) and from birth to weaning (0.57 kits), kit weight at birth (76.6 g) and at weaning (485 g) and kit weight gain per day (14.6 g). The unfavourable effects of the hot summer conditions on the studied traits were in accordance with the results obtained by MARAI *et al.* (1992, 1994 a & b and 1996), under the same conditions. In winter, the majority of the mentioned traits showed the highest values. Such results clarify the reasons why the rabbit breeding "season" is restricted to the mild climate period of the year, i.e. extends from October to April or May each year in Egypt as a sub-tropical region.

The interaction between open days classes and each of litter size classes and year seasons and that between open days classes, litter size classes and year seasons on the majority of the studied traits, were not significant (Tables 1 and 2). The significant (P<0.05) interaction was only between open days and litter size classes on kit weight at weaning and kit weight gain. The interaction between litter size classes and year seasons was not significant on most of the studied traits. Only the interaction between litter size classes and year seasons on kit weight at birth was significant (P<0.05). The significant interaction values obtained above were probably due to the different trends shown by the estimated traits within the defined classes of the factors affecting in the present study.

The comparison between the obtained results in the present study and that were carried out in other countries in hot climate regions shows that numbers of litters/year were 6.0 – 6.2 in Cuba (PONCE DE LEON, 1996) and 7 litters in South Africa (SONANDI *et al.*, 1996) which were lower than that estimated in Egypt (8.7 litters). The number of kits/litter was about 8 – 9 in South Africa (SONANDI *et al.*, 1996) which was higher than that obtained under the conditions in Egypt, when applying intensive rabbit production system.

Table 2 : Milk yield, milk intake, kit body weight and gain and milk conversion ratio as affected by open days, litter size, year season and their interactions in New Zealand White rabbits.

Items	No of litters	Milk yield (g/day)	Milk intake/ kit/day (g)	Mean kit weight (g) Birth	Weaning	Kit gain (g/d) (0-28 days)	Milk conversion
Open days classes							
≤ 10	414	112.6±1.8	24.3±0.4	71.4±0.6	468.7±2.6	14.2±0.09	1.7±0.03
11 – 20	109	109.6±4.1	24.2±0.6	71.7±1.8	482.8±5.6	14.7±0.20	1.7±0.04
21 – 30	89	118.7±4.8	23.7±0.8	74.0±2.2	471.2±5.1	14.2±0.15	1.7±0.05
> 30	135	130.8±3.8	24.9±0.6	73.3±2.2	471.8±4.6	14.2±0.16	1.8±0.04
Significance		NS	NS	NS	NS	NS	NS
Litter size classes							
≤ 4	180	83.9±2.1	28.4±0.58	89.9±2.1	505.7±4.1	14.9±0.15	1.9±0.04
5 – 7	355	113.6±1.8	24.3±0.35	69.4±0.6	472.1±2.8	14.4±0.10	1.7±0.02
≥ 8	212	147.8±2.6	20.9±0.29	61.5±0.7	442.3±2.3	13.6±0.08	1.5±0.02
Significance		***	***	***	***	***	***
Year season							
Winter	182	131.7±3.0	25.2±0.51	73.4±1.6	469.4±4.0	14.2±0.13	1.8±0.04
Spring	227	120.5±2.8	25.2±0.45	70.1±1.1	475.5±3.5	14.5±0.12	1.7±0.03
Summer	93	84.8±3.7	22.3±0.56	76.6±2.8	484.6±5.1	14.6±0.17	1.5±0.05
Autumn	245	112.5±2.2	23.6±0.48	71.3±1.2	464.8±3.5	14.1±0.12	1.7±0.03
Significance		***	**	*	NS	NS	**
Interaction between open days classes and litter size classes							
≤ 10 days							
≤ 4	100	83.2±2.8	28.3±0.73	86.2±2.4	500.6±5.6	14.8±0.20	1.9±0.06
5 – 7	214	114.8±2.1	24.5±0.50	69.2±0.8	466.7±3.5	14.3±0.13	1.7±0.03
≥ 8	100	137.1±3.6	20.0±0.38	61.3±1.1	441.5±3.3	13.7±0.12	1.5±0.03
11 - 20 days							
≤ 4	25	81.5±5.7	27.2±1.45	93.5±4.8	498.7±10.6	14.5±0.41	1.8±0.12
5 – 7	53	99.4±4.6	24.3±0.64	68.0±1.4	498.0±8.7	15.5±0.32	1.6±0.05
≥ 8	31	149.9±6.9	21.5±0.97	60.6±1.5	444.3±4.7	13.4±0.18	1.6±0.06
21 - 30 days							
≤ 4	20	82.0±6.3	30.3±2.26	97.1±6.4	530.1±11.8	15.6±0.37	2.0±0.13
5 – 7	40	111.8±5.8	21.9±0.79	71.6±1.5	460.5±5.1	13.9±0.20	1.6±0.06
≥ 8	29	153.6±7.7	21.8±0.73	61.3±2.0	445.4±4.7	13.7±0.15	1.6±0.06
> 30 days							
≤ 4	35	88.9±5.3	28.4±1.38	93.7±7.0	510.7±7.3	14.9±0.32	1.9±0.11
5 – 7	48	125.5±4.6	25.6±0.88	69.9±1.6	476.9±7.9	14.5±0.27	1.8±0.06
≥ 8	52	164.0±4.9	21.7±0.60	62.7±1.2	441.0±5.5	13.5±0.20	1.6±0.04
Significance		NS	NS	NS	*	*	NS
Interaction between litter size classes and year season							
≤ 4							
Winter	44	95.7±4.1	30.0±1.22	95.7±4.2	509.4±7.5	14.8±0.27	2.0±0.09
Spring	55	83.6±3.5	28.8±1.14	83.9±2.7	507.4±5.1	15.1±0.21	1.9±0.08
Summer	26	63.4±5.5	26.2±1.21	101.2±7.6	518.2±12.2	14.9±0.45	1.7±0.14
Autumn	55	84.5±3.7	27.7±0.99	85.9±3.9	495.3±8.5	14.6±0.31	1.9±0.07
5 - 7							
Winter	75	127.8±3.8	25.7±0.67	68.5±1.2	472.0±6.4	14.4±0.23	1.8±0.05
Spring	98	117.7±3.0	25.9±0.55	69.7±1.1	482.1±5.9	14.7±0.22	1.8±0.04
Summer	50	85.0±4.6	21.3±0.61	69.2±1.2	475.4±5.3	14.5±0.19	1.5±0.05
Autumn	132	113.4±2.5	23.5±0.70	69.8±1.0	463.3±4.0	14.1±0.16	1.7±0.04
≥ 8							
Winter	63	161.5±4.4	21.3±0.56	63.6±1.5	439.0±4.1	13.4±0.15	1.6±0.04
Spring	74	151.7±4.7	21.5±0.56	60.5±1.1	443.0±3.8	13.7±0.13	1.6±0.04
Summer	17	116.5±7.3	19.3±0.95	60.6±1.9	462.2±8.8	14.3±0.31	1.3±0.06
Autumn	58	137.3±4.3	20.2±0.41	60.9±1.3	439.3±4.2	13.5±0.15	1.5±0.03
Significance		N	NS	*	NS	NS	NS

* P< 0.05, ** P<0.01, *** P< 0.001 and NS = not significant. Interaction between open days classes and year season did not show any significant effect., nor interaction between open days classes, litter size classes and year seasons.

Comparison between the above mentioned figures and those estimated as intensive production system of rabbits (6–7 litters/year and 6–7 kits per litter; FAO, 1986), shows that the obtained results in hot climates are within or may be higher than such figures. In addition, more improvement in such traits may be expected when more attention is directed towards amelioration of the climatic heat either by modification of the environment (HABEEB *et al.*, 1994) reducing animals heat production (AYYAT and MARAI, 1996 and 1997) and increasing their body heat losses (HABEEB *et al.*, 1994 and MARAI *et al.*, 1994 a and 1996).

In conclusion, the results obtained in the present study (8.7 litters per year and 6.4 kits per litter at birth), together with those obtained in other hot climate countries indicate success of application of the intensive production system under the hot climate conditions.

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