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REPRODUCTIVE PERFORMANCE OF NEW ZEALAND WHITE RABBIT DOES AND PRODUCTIVE PERFORMANCE OF THEIR BUNNIES AS AFFECTED BY INGECTION OF VITAMINS AD_3E DURING SUMMER AND AUTUMN SEASONS

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ABSTRACT

The current study was conducted to evaluate the effect of season and injection of different levels of vitamin AD_3E on some productive of New Zealand White (NZW) doe rabbits and reproductive traits of their bunnies. Does were divided into five groups (10 does in each group). The 1st was control group (injected with 1.00 ml saline solution, the 2nd, 3rd, 4th and 5th groups were injected at levels of 0.5, 1.0, 1.5 and 2.0 ml/doe from vitamins AD_3E, respectively. All does were injected every 15 days during the experimental period (summer and autumn 2005). Results showed that Number of service per conception (NSC), days open (DO) and Kindling interval (KI) were lower ($P<0.01$) in summer (2.01 services, 16.04 and 46.59 days) than in autumn (2.92 services, 29.45 and 59.6 days), while gestation period length (GPL) showed an opposite trend (30.30 vs. 30.87 days). Each of litter size (LS), litter weight (LW) and bunny gain (BG) at birth was not affected significantly by season, while each of LS, LW and BG at 21 and 35 days of age as well as mean bunny weight (MBW) were higher ($P<0.01$) in autumn than in summer. However, mortality rate (MR) at birth and 35 days of age was not affected by season, and was higher ($P<0.01$) in summer than in autumn at 21 days of age. The effect of level of injection was significant ($P<0.05$) on NSC, LS and LW at 35 days, and MBW and BG at 0, 21 and 35 days of age, being the highest and on MR at 0, 21 and 35 days of age, being the lowest in doe rabbits injected with 1.0 ml AD_3E.

In conclusion, biweekly injection of doe rabbits with AD_3E at a level of 1.0 ml reduced number of services per conception and improved mean weight and daily gain as well as viability of produced bunnies during autumn and summer.

Keywords: Rabbit, season, AD_3E, reproduction, litter size, litter weight.

INTRODUCTION

The New Zealand White (NZW) Rabbit as a commercial meat rabbit breed was recently introduced in Egypt in order to participate in increasing meat production as it is a prolific animal, fast growing and high fecundity. Under the Egyptian conditions, these advantages are affected to a great extent by several factors such as the environmental and managerial conditions (Yamani *et al.*, 1991).

Vitamins are essential for normal health and different physiological functions of different species. It is known that vitamin A plays a role in regulation of the stability and structure of the biological substance as one of the physiological functions and it is necessary for the maintenance of normal epithelial tissue. In rabbits, vitamin A deficiency in does causes hydrocephalus (fluid accumulation in the head) of their kits, low conception rat, fetal resumption, abortion, small weak litters, poor maternal abilities and lack of milk production (Cheek *et al*., 1984). Several authors indicated that vitamin A is necessary for growth, fertility, and maintenance of pregnancy in rabbits (Is mail *et al*., 1992). Many of the signs of vitamin A toxicity are similar to those of a deficiency in chicken, such as reduced growth, bone abnormalities, and reproductive failure (Scott *et al*., 1982).

Vitamin D_3 has an important role in calcium and phosphorus metabolism. It affects fetal mortality, appetite, diarrhea, ataxia, paralysis (Zimmerman *et al*., 1990).

Vitamin E plays an important role in the immune system function and regulates the metabolism of thyroid hormones (Gore and Qureshi, 1997). It is a biological antioxidant, although its fundamental function is maintenance and protection of cell membranes permeability. Vitamin E deficiency produces liver fat degeneration, muscular dystrophy and sudden mortalities by cardiac lesions (El-Husseiny *et al*., 1997). The main signs of vitamin E deficiency are muscular dystrophy in the growing rabbit and poor reproductive performance, abortion and still-birth in pregnant does (Yamani and Stein, 1989).

Since the ration is not balanced and animals are not fed with greenery, a combination of vitamins AD_3E is administered for the prevention of symptoms due to lack of vitamins A, D_3 and E observed often during the summer and the beginning of autumn. Also, weak young animals which are born during summer or autumn are administered with AD_3E.

The present work aimed to study the effects of injection New Zealand White rabbit does with different levels of vitamin AD_3E on the reproductive performance of does and productive performance of their bunnies during the summer and autumn.

MATERIALS AND METHODS

The experimental work was carried out in the Rabbit Production Farm, Agricultural Researches and Experiments Station, Faculty of Agriculture, Mansoura University, during the period from July to December 2005.

Animals and housing:

Total of fifty mature New Zealand White does (5-6 months of age and 2.75-3.25 kg body weight were used in this study. Each doe was individually housed in wired cages (50 x 60 x 40 cm) provided with a metal nest box for kindling and nursing their bunnies during the suckling period, and equipped with feeders and nipples. However, five sexually mature rabbit bucks were used for natural mating. All bucks were kept under the same condition of does.

Experimental groups:

The experimental rabbits were divided into five groups, 10 does in each group. Does in the 1st group were subcutaneously injected with 1.0 ml saline solution (0.9%) and was considered as a control group. While, those in the 2nd, 3rd, 4th and 5th groups were subcutaneously injected with AD_3E at levels of 0.5, 1.0, 1.5 and 2.0 ml/doe, respectively. All does were injected biweekly during the experimental period (summer and autumn seasons).

Does and bucks were fed pelleted diet (18% CP and 2600Kcal/kg diet) according to NRC (1977). Feeds were offered *ad libitum* all over the experimental period.

Experimental procedures:

Throughout the experimental period, does with red or rose vulva were naturally mated with sexually mature bucks, and pregnancy was diagnosed at 10-12 days after mating and non-conceived does were re-mated. Reproductive performance of doe rabbits including number of services per conception (NSC), days open (interval from kindling to next conception), and gestation period length (GPL) and kindling interval (KL) were calculated. Also, litter size and litter weight at birth was recorded for each group

On the other hand, productive traits of produced bunnies involved litter size and litter weight at 0 (birth), 21 and 35 (weaning) days of age were recorded. Also, bunnies were weekly weighed and average daily gain (ADG) during suckling period was calculated at intervals from 0-21, 21-35 and 0-35 days. Mortality rates (MR) of bunnies at 0, 21 and 35 days of age were also recorded.

Statistical analysis:

Data were statistically analyzed by the method of analysis of variance using computer program of SAS (2001). Significant group differences were set at a level of P<0.05 using Duncan's new multiple rang test (Duncan, 1955).

RESULTS AND DISCUSSION

Reproductive performance of does:

Effect of season:

Data in Table (1) revealed that number of services per conception (NSC) were significantly (P<0.01) higher by 45.3% in autumn than in summer (2.01 vs. 2.92). This trend is in agreement with that reported by Prayaga and Eady (2002) Ghosh *et al.* (2004) and Marai *et al* (2006), who observed that the effect of season on NSC was significant, being higher in autumn than in summer season. However, Zerrouki *et al.* (2005) found that the effect of season on conception rat was not significant. As a result of increasing NSC in autumn than summer season, also days open (DO) were significantly (P<0.01) longer by 83.6% in autumn than in summer season (16.04 vs. 29.32 days, Table 1). In similarity with the present difference, Abd El-Rauf (1993) and Khalil *et al.* (1995) showed that DO were significantly (P≤0.01) longer in autumn than in winter

Gestation period length (GPL) was significantly longer by 1.8% in summer than in autumn season (30.30 vs. 30.87 days, Table 1). These results are in agreement with those reported by Hassan (1995); Hassan *et al.* (1995) and Farghaly (1996), who showed similar trend of differences in GPL of NZW does between summer and autumn seasons. Similar trend was observed by Marai *et al*. (2006) on NZW and Californian doe rabbits. However, Abd El-Rauf (1993) showed insignificant differences in GPL of NZW and Californian doe rabbits during autumn, winter and spring.

Table (1): Number of service per conception (NSC), days open (DO), gestation period length (GPL) and kindling interval (KI) of NZW doe rabbits as affected by season, level of AD_3E injection and their interaction.

Variable	Reproductive parameter			
	NSC	DO	GPL	KI
Effect of season:				
Summer (S)	2.01±0.21[B]	16.04±4.22[B]	30.87±0.10[A]	46.59±4.2[B]
Autumn (A)	2.92±0.20[A]	29.45±1.76[A]	30.30±0.07[B]	59.60±1.7[A]
Sign.	**	**	**	**
Effect of injection level:				
Control (C)	3.17±0.36[a]	19.88±7.56	30.49±0.13	50.42±7.5
0.5 ml	2.36±0.34[ab]	3.61±4.66	30.63±0.12	53.97±4.6
1.0 ml	1.62±0.30[b]	19.04±3.06	30.52±0.11	49.38±3.0
1.5 ml	2.06±0.30[b]	22.81±3.48	30.56±0.11	53.04±3.5
2.0 ml	3.13±0.34[a]	28.39±5.50	30.58±0.12	58.67±5.5
Sign.	*	NS	NS	NS
Effect of interaction:				
S x C	3.20±0.55	10.00±14.5	30.77±0.21	41.00±14.6
S x 0.5 ml	1.55±0.58	17.00±8.41	30.83±0.18	47.33±8.45
S x 1.0 ml	1.50±0.55	16.70±4.60	30.77±0.14	47.30±4.63
S x 1.5 ml	1.66±0.71	17.00±5.94	30.75±0.15	47.33±5.97
S x 2.0 ml	2.40±0.78	19.50±10.3	30.90±0.19	50.00±10.3
A x C	3.14±0.46	29.76±4.04	30.21±0.16	59.84±4.06
A x 0.5 ml	3.14±0.46	30.23±4.04	30.42±0.16	60.61±4.06
A x 1.0 ml	1.80±0.48	21.38±4.64	30.23±0.16	51.46±4.06
A x 1.5 ml	2.56±0.43	28.62±3.64	30.37±0.15	58.75±3.66
A x 2.0 ml	2.40±0.70	37.28±3.89	30.27±0.16	67.35±3.91
Sign.	NS	NS	NS	NS

Mean bearing different letters within the same column for each classification are significantly (P≤0.05) different.

The observed significant increase in each of NSC and DO in autumn than in summer was reflected in significantly (P<0.01) longer kindling interval (KI) in autumn than in summer by about 28% (46.59 vs. 59.60 days, Table 1). In accordance with the present results, several investigators showed that KI was significantly (P≤0.01) higher in autumn than in summer (Nasr, 1994 and Tizhe *et al.*, 2006). However the recent results of Ghosh *et al.* (2004) showed that KI of NZW and Soviet Chinchilla doe rabbits did not differ significantly in winter and summer seasons.

Results in Table (2) show that litter size (LS) and litter weight (LW) at birth were slightly higher in summer than in autumn, being 6.31 and 6.86 for LS and 341.3 and 413.9 g for LW, respectively, but the difference was not significant. In agreement with the present LS at birth, Hassan (1995) and Ghosh *et al.* (2004) showed that the effect of season on LS at birth was not significant. Also, Nasr (1994) and Ghosh *et al.* (2004) found insignificant effect of season on LW at birth. Contrarily, the differences in LS at birth (El-Raffe, 1994 and Zerrouki *et al.*, 2005) or in LW at birth (Zerrouki *et al.*, 2005 and Marai *et al.*, 2006) were reported to be significantly ($P\leq0.01$) higher.

Effect of AD_3E level:

Effect of level of AD_3E reproductive performance of doe rabbits was significant ($P<0.05$) only on NSC, however, each of DO, KI and GPL were not affected significantly by level of injection (Table 1). Average of NSC significantly ($P<0.05$) reduced with levels of 1.0 and 1.5 ml by about 49 and 35% as compared to the control, respectively. However, level of 0.5 and 2.0 ml insignificantly decreased NSC by about 25.0 and 1.26%, respectively.

In agreement with the observed improvement in NSC as affected by AD_3, dietary supplementation with vitamin E (Shetaewi, 1998) or vitamin A (Daader *et al.*, 1999) were reported to improve conception rate of doe rabbits. Also, Parig *et al.* (1983) showed that NSC was 2.16 and 1.18 for doe rabbits fed diets supplemented with 0 and 40 mg/kg of beta-carotene, respectively. Recently, Gad Alla *et al.* (2002a) found lower NSC in NZW doe rabbits injected with AD_3E compared with the control group. The insignificant effect of AD_3E on GPL was indicated by several authors (Metwally *et al.*, 2001; Abd-El-Monem *et al.*, 2003 and Gad Alla *et al.*, 2002a).

Results in Table (2) clear that the effect of AD_3E level on LS and LW at birth was not significant, although there was a tendency of the greatest LS and the heaviest LW at birth of bunnies produced from does injected with a level of 1.0 ml AD_3E. These results agreed with those reported by Metwally *et al.* (2001) and Abd-El-Monem *et al.* (2003), who showed that LS of does at birth were not affected significantly by vitamins A or E. Also,Gad Alla *et al.* (2002a) found insignificant effect of AD_3E injection on LS and LW at birth of NZW, Californian and Baladi doe rabbits. However, effect of vitamins was significant on LS and LW of NZW doe rabbits at birth (Zeidan *et al.*, 2001).

It is of interest to note that the effect of interaction between season and level of injection on reproductive traits of doe rabbits was not significant indicating more pronounced effect rather than level of injection on most of these traits, except for NSC which markedly improved in does treated with 1.0 ml AD_3E compared to control in autumn (1.80 vs. 3.14) or summer (1.5 vs. 3.2, Table 1).

Table (2): Litter size and litter weight at 0 (birth), 21 and 35 (weaning) days of age of NZW doe rabbits as affected by season, injection level and their interaction.

Variable	Litter size			Litter weight (kg)		
	At birth	At 21 days	At 35 days	At birth	At 21 days	At 35 days
Effect of season:						
Summer (S)	6.31±0.22	5.35±0.19^{B}	5.09±0.19^{B}	341.3±46.4	1575.8±95.7^{B}	3258.4±127.4^{B}
Autumn (A)	6.86±0.20	6.30±0.18^{A}	5.75±0.17^{A}	414.0±43.5	2069.7±89.6^{A}	4004.6± 119.3^{A}
Sign.	NS	**	**	NS	**	**
Effect of injection level:						
Control (C)	6.65±0.36	5.70± 0.33	5.11±0.32^{b}	319.2±78.0	1799.8±160.7	2997.3±213.8^{c}
0.5 ml	6.09±0.34	5.50± 0.31	5.30±0.29^{ab}	327.7±72.9	1697.7±150.3	3601.3±200.0^{b}
1.0 ml	6.78±0.30	6.33± 0.27	6.22±0.26^{A}	382.6±64.8	2025.1±133.6	4419.9±177.7^{a}
1.5 ml	6.75±0.31	5.84± 0.28	5.18±0.26^{B}	336.7±65.5	1817.5±135.1	3661.6±179.7^{b}
2.0 ml	6.35±0.34	5.76± 0.31	5.29±0.30^{ab}	322.1±73.6	1773.6±151.7	3477.7±201.8^{cb}
Sign.	NS	NS	**	NS	NS	**
Effect of interaction:						
S x C	6.09±0.55	5.04±0.50	5.00±0.48	301.0±111.1	1339.5±241.7	2793.0±321.6
S x 0.5 ml	6.33±0.50	5.50±0.45	5.33±0.43	315.4±107.0	1688.3±220.6	3422.5±293.5
S x 1.0 ml	6.11±0.41	5.61±0.37	5.44±0.35	331.1±87.4	1756.1±180.1	3794.4±239.7
S x 1.5 ml	6.31±0.44	5.00±0.39	4.50±0.38	475.9±92.7	1513.1±191.0	3053.1±254.2
S x 2.0 ml	5.90±0.53	5.27±0.47	5.18±0.45	283.2±111.8	1581.8±230.4	3229.1±306.6
A x C	6.00±0.47	6.00±0.43	5.23±0.42	337.3±102.9	2260.0±212.0	3201.5±282.0
A x 0.5 ml	5.85±0.47	5.50±0.42	5.28±0.40	340.0±99.1	1707.1±204.2	3780.0±271.8
A x 1.0 ml	7.46±0.45	7.06±0.40	7.00±0.39	434.0±95.8	2294.0±197.3	5045.3±262.5
A x 1.5 ml	7.18±0.44	6.68±0.39	5.87±0.38	597.5±92.7	2121.9±191.0	4270.0±254.2
A x 2.0 ml	6.80±0.45	6.26±0.40	5.40±0.39	361.0±95.81	1965.3±97.30	3726.3±262.5
Sign.	NS	NS	NS	NS	NS	NS

Mean bearing different letters within the same column for each classification are significantly ($P \leq 0.05$) different.
NS: Not significant

Productive performance of bunnies:

Litter size and litter weight:

Effect of season:

The effect of season on LS at 21 and 35 days of bunny age was significant (P<0.01), being higher by 17.7 and 12.9% in autumn than in summer season, respectively (Table 2). These results are in agreement with those reported by Farghaly and EL-Darawany (1994), who showed that the differences in LS at 21 days of age between seasons were significantly higher (P≤0.01). Also, El-Raffe (1994) and Prayaga and Eady (2002) found significant effect of season on LS at weaning. On the other hand, Nasr (1994) and Hassan (1995) showed that the differences between seasons of litter size at 21 days of age were not significant. While, Ghosh *et al.* (2004) and Zerrouki *et al.* (2005) showed insignificant differences in LS at weaning in different seasons.

As affected by LS, also LW at 21 and 35 days of age was affected significantly by season, being heavier by 31.3 and 23.0% in autumn than in summer (Table 2). Similar trend was obtained for LW at 21 days of age by Hassan (1995) and Marai *et al.* (2006) and at 35 days of age by Zerrouki *et al.* (2005) and Marai *et al.* (2006). However, Nasr (1994) showed that the differences in LW at 21 days of NZW and Californian doe rabbits were not significant among seasons. Also, Sallam *et al.* (1992) showed that the differences in LW at weaning were not significant among seasons.

Effect of AD_3E level:

Rabbit does injected with 1.0 ml from AD_3E showed the highest LS and LW at 21 and 35 days of age, but the differences were significant only at 35 days of age (Table 2). It is of interest to note that the effect of level of AD_3E was more pronounced on LW than LS at 35 days of age.

The present results are in agreement with those reported on LS at 21 days of NZW does injected with 1000 IU from vitamin A (Metwally *et al.*, 2001) and on LW at 21 days of NZW, Californian and Baladi doe rabbits injected with AD_3E (Gad Alla *et al.*, 2002a). Also, the significant effect of vitamin level on LS and LW at 35 days was reported by several authors (Gad Alla *et al.*, 2002b and Abd-El-Monem *et al.*, 2003).

In contrast to the present results, Metwally *et al.* (2001) reported significant (P<0.01) effect of injection of NZW doe rabbits with vitamin A (1000 IU) on LS and LW at 21 days. Also, Gad Alla *et al.* (2002a) found that LS at 21 day of does was affected significantly (P≤0.05) by AD_3E injection.

Generally, the effect of interaction between season and level of AD_3E on LS and LW at 0, 21 and 35 days of age was not significant (Table 2).

Mean weight and daily gain of bunnies:

Effect of season:

Mean bunny weight (MBW) at 0, 21 and 35 days of age and average daily gain (ADG) of bunnies at intervals from 0-21, 21-35 and 0-35 days was affected by season. All traits were higher in autumn than in summer season and the differences were significant (P<0.01), except for ADG at interval of 0-21 days (Table 3).

Table (3): Mean bunny weight at 0 (birth), 21 and 35 (weaning) days of age and average daily gain of bunnies as affected by season, injection level and their interaction.

Variable	Mean bunny weight (kg)			Daily weight gain		
	At birth	At 21 days	At 35 days	0-21 days	21-35 days	0- 35 days
Effect of season:						
Summer (S)	50.45±0.55^{B}	300.20±2.18^{B}	644.28±5.59^{B}	11.96± 0.09	24.77± 0.36^{B}	17.17± 0.15^{B}
Autumn (A)	56.89±0.52^{A}	314.36±2.04^{A}	699.84±5.23^{A}	12.19± 0.08	27.[illegible]0± 0.34^{A}	18.31± 0.14^{A}
Sign.	**	**	**	NS	**	**
Effect of injection level:						
Control (C)	48.71± 0.94^{d}	279.71±3.67^{c}	589.03±9.38^{d}	11.11± 0.15^{B}	22.71± 0.61^{D}	15.87± 0.25^{D}
0.5 ml	55.66±0.87^{Ab}	317.14±3.43^{ab}	685.56±8.77^{b}	12.54± 0.14^{A}	26.54± 0.57^{BC}	18.16± 0.24^{B}
1.0 ml	58.11±0.78^{a}	321.50±3.05^{a}	728.94±7.80^{a}	12.51± 0.13^{A}	28.47± 0.51^{A}	19.03± 0.21^{A}
1.5 ml	53.90±0.79^{Bc}	311.25± 3.08^{b}	698.90±7.88^{b}	12.20± 0.13^{A}	27.28± 0.51^{AB}	18.35± 0.21^{AB}
2.0 ml	51.98±0.88^{c}	306.81±3.46^{b}	657.87±8.85^{c}	12.03± 0.14^{A}	25.18± 0.58^{C}	17.30± 0.24^{C}
Sign.	*	*	*	**	**	**
Effect of interaction:						
S x C	45.90± 1.41	272.50± 5.52	565.00±14.11	11.01± 0.23	22.13± 0.92	15.62± 0.39
S x 0.5 ml	52.75± 1.29	312.50± 5.04	650.41±12.88	12.55± 0.21	24.69± 0.84	17.41± 0.35
S x 1.0 ml	55.55± 1.05	318.33± 4.11	712.22±10.51	12.61± 0.17	27.45± 0.69	18.63± 0.29
S x 1.5 ml	49.43± 1.11	304.06± 4.36	669.68±11.15	12.10± 0.18	25.85± 0.73	17.78± 0.30
S x 2.0 ml	48.63± 1.34	293.63± 5.26	624.09±13.45	11.53± 0.22	23.73± 0.88	16.43± 0.37
A x C	51.53± 1.23	286.92± 4.84	613.07±12.37	11.20± 0.20	23.29± 0.81	16.12± 0.34
A x 0.5 ml	58.57± 1.19	321.78± 4.66	720.71±11.92	12.52± 0.19	28.38± 0.78	18.91± 0.32
A x 1.0 ml	60.66± 1.15	324.66± 4.51	745.66±11.52	12.40± 0.19	29.49± 0.75	19.43± 0.31
A x 1.5 ml	58.37± 1.11	318.43± 4.36	728.12±11.15	12.30± 0.18	28.72± 0.73	18.93± 0.30
A x 2.0 ml	55.33± 1.15	320.00± 4.51	691.66±11.52	12.53± 0.19	26.63± 0.75	18.17± 0.31
Sign.	NS	NS	NS	*	NS	NS

Mean bearing different letters within the same column for each classification are significantly ($P \leq 0.05$) different.
NS: Not significant

It is worthy noting that MBW at 0, 21 and 35 days was almost associated with LS at these ages within each season (Table 2). Also, ADG of bunnies at different intervals was in strong relation to MBW at birth (Table 3).
Similar effect of season was reported on MBW at birth (Prayaga and Eady, 2002 and Marai *et al.* (2006) at 21 days of age (Youssef, 1992) and at weaning (Ghosh, *et al.*, 2004). However, no significant effect was found for season on MBW at birth and weaning (Zerrouki *et al.*, 2005). Also, the significant effect of season on ADG of growing rabbits was reported on NZW by Marai, *et al.* (2001) and Eiben *et al.* (2003).

Effect of AD_3E level:

The effect of AD_3E level on MBW at 0, 21 and 35 days of age was significant ($P<0.05$). Mean bunny weight at all ages was significantly ($P<0.05$) higher in all treatment groups as compared to the control, being the highest in does injected with 1.0 ml from AD_3E (Table 3).
Mean bunny weight significantly ($P<0.05$) increased by 13.4, 14.9, 11.3 and 9.7%) for does injected with 0.5, 1.0, 1.5 and 2.0 ml AD_3E, as compared to the control does, respectively. These results agreed with those reported by Sedki *et al.* (2002) and Sonbol *et al.* (2005). Contrarily, El-Husseiny *et al.* (199‹) and Metwally *et al.* (2001) found that the effect of injection of vitamins A and E on mean bunny weight at weaning was not significant. Also, the effect of injection of NZW, Californian and Baladi doe rabbits with AD_3E on mean bunny weight at 0, 21and 35 days was not significant (Gad Alla *et al.*, 2002a).

The effect of AD_3E level on ADG of bunnies at 0-21, 21-35 and 0-35 days of age was significant ($P<0.05$), being higher in all treatment groups than the control group. Bunnies produced by doe rabbits injected with 1.0 ml AD_3E significantly ($P<0.05$) showed the highest values, being higher by 12.6, 25.4 and 19.9% than the control group at age intervals of 0-12, 12-35 and 0-35 days, respectively (Table 3). These results agreed those reported by Zeidan *et al.* (2001); Metwally *et al.* (2001) and Gad Alla *et al.* (2002a). While, results of Sedki *et al.* (2002) and Yousef *et al.* (2003) disagreed those obtained in this study..
Interestingly to observe that the effect of interaction between season and level of AD_3E on MBW at 0, 21 and 35 days and ADG of bunnies at 0-21, 21-35 and 0-35 days of age was not significant.(Table 3).

Mortality rate:

Effect of season:

The effect of season on mortality rate (MR) of bunnies at birth and weaning was not significant. However, MR was significantly ($P<0.01$) higher in summer than in autumn (8.4 vs. 15.5%, Table 4). This trend was indicated at birth by Zerrouki *et al.* (2005). However, the significant effect of season on MR at 21 days of age was reported by Farghaly and EL-Darawany (1994), who found significant ($P\leq0.01$) differences in MR at 21days during autumn, winter, spring and summer.

On the other hand, the effect of season on MR of NZW and Californian (Tawfeek and El-Hindawy (1991) and NZW, Californian, and chinchilla bunnies (Sallam *et al.* (1992) at 21 days of age was not significant. Also, Youssef (1992) showed that the differences in MR at weaning were significant (P≤0.01).

Table (4): Mortality rate of bunnies at 0, 21 and 35 days of age as affected by season, injection level and their interaction.

Variable	Mortality rate (%)		
	At birth	At 21 days	At 35 days
Effect of season:			
Summer (S)	5.27±0.01	15.53±0.01[a]	20.20±0.01
Autumn (A)	4.06±0.00	8.42±0.01[b]	16.44±0.01
Sign.	NS	**	NS
Effect of injection level:			
Control (C)	9.55±0.01[a]	21.60±0.02[a]	29.70±0.02[a]
0.5 ml	3.16 ±0.01[b]	9.49±0.02[b]	12.65±0.02[bc]
1.0 ml	4.05±0.01[b]	7.22±0.02[b]	9.02±0.02[d]
1.5 ml	4.33±0.01[b]	13.87±0.02[b]	23.48±0.02[ab]
2.0 ml	2.26±0.01[b]	7.69±0.02[b]	16.73±0.02[bc]
Sign.	*	**	**
Effect of interaction:			
S x C	9.33±0.02	28.00±0.03	33.33±0.04
S x 0.5 ml	5.06±0.02	12.65±0.03	15.18±0.04
S x 1.0 ml	3.63±0.01	9.09±0.03	10.90±0.03
S x 1.5 ml	6.93±0.01	20.79±0.03	28.71±0.03
S x 2.0 ml	1.42±0.02	7.14±0.03	12.85±0.04
A x C	9.78±0.02	15. 21±0.03	26.08±0.03
A x 0.5 ml	1.26±0.02	6.32±0.03	10.12±0.04
A x 1.0 ml	4.46±0.01	5.35±0.02	7.14±0.03
A x 1.5 ml	1.73±0.01	6.95±0.02	18.26±0.03
A x 2.0 ml	3.09±0.02	8.247±0.03	20.61±0.04
Sign.	NS	NS	NS

Mean bearing different letters within the same column for each classification are significantly (P≤0.05) different.

Effect of AD_3E level:

The effect of AD_3E level on mortality rate (MR) of bunnies at 0, 21 and 35 days was significant, being lower for all treatment groups than the control group. The lowest values of MR at all ages were obtained for bunnies of does injected with AD_3E at a level of 1.0 ml (Table 4). Results of MR at birth are in agreement with those reported by Is mail *et al.* (1992) and Shetaew *et al.* (1998). However, Gad Alla *et al.* (2002b) found that MR values at birth, 21 days and weaning of NZW, Californian and Baladi bunnies were not affected significantly by injection of doe rabbits with AD_3E.

In conclusion, biweekly injection of doe rabbits with AD_3E at a level of 1.0 ml reduced number of services per conception and improved mean weight and daily gain as well as viability of produced bunnies during autumn and summer.

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تأثير الحقن بمستويات مختلفة من فيتامين أد$_3$ه على الكفاءة التناسلية لإناث أرانب النيوزيلندي الأبيض والكفاءة الإنتاجية لصغارها خلال موسمي الصيف والخريف

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أجريت هذه الدراسة في مزرعة الأرانب - قسم إنتاج الدواجن - كلية الزراعة - جامعة المنصورة خلال الفترة من يوليو حتى ديسمبر 2005 على عدد 50 أنثى من أرانب النيوزيلندي الأبيض وكان الهدف من الدراسة معرفة تأثير كل من موسم الإنتاج والحقن بمستويات مختلفة من فيتامين اد$_3$ه على الكفاءة التناسلية لإناث أرانب النيوزيلندي الأبيض و الكفاءة الإنتاجية لصغارها. قسمت الإناث إلى خمس مجموعات بكل منها عشرة إناث، المجموعة الأولى حقنت ب 1ملل محلول ملحي والمجموعات الثانية والثالثة والرابعة والخامسة حقنت بمستويات 0.5، 1، 1,5 ، 2ملل على التوالي كل خمسة عشر يوم خلال فترة التجربة (صيف وخريف 2005).

وكانت أهم النتائج المتحصل عليها :

*عدد التلقيحات اللازمة للإخصاب ، الفترة المفتوحة ،الفترة بين ولادتين انخفضت بدرجة معنوية(1.0) في فصل الصيف مقارنة بفصل الخريف حيث كانت 2.01تلقيحه ،16.04، 46.59 يوم في فصل الصيف مقابل 2.92تلقيحة، 29.45، 59.60 يوم في فصل الخريف في حين أوضحت مدة الحمل اتجاه مضاد حيث كانت في الخريف 30.3 مقابل 30.87يوم في فصل الصيف.

*لم يكن هناك اختلافات معنوية في صفات حجم البطن ، وزن البطن ، الزيادة في وزن الجسم عند الميلاد ولكن نفس الصفات عند أعمار 21 يوم ، 35 يوم وكذلك متوسط الوزن الفردي عند مختلف الأعمار كانت اعلي بدرجة معنوية في فصل الخريف مقارنة بفصل الصيف، في حين لم يكن هناك تأثيرات معنوية للموسم على نسبة النفوق عند الميلاد وعند عمر 35 يوم إلا أنها كانت اعلي بدرجة معنوية (10.0) في فصل الصيف مقارنة في فصل الخريف عند عمر 21 يوم .

*كان لحقن الفيتامين بمستوياته المختلفة تأثيرا معنويا بدرجة (50.0)على عدد التلقيحات اللازمة للإخصاب ، حجم البطن ، وزن البطن عند عمر 35 يوم ، الزيادة في وزن الجسم وكذلك متوسط الوزن الفردي عند مختلف الأعمار كانت اعلي بدرجة معنوية في فصل الخريف مقارنة بفصل الصيف ، في حين لوحظ انخفاض واضح في نسبة النفوق عند مختلف الأعمار مع الإناث المحقونة بمستوى 1 ملل فيتامين اد$_3$ه.

*الخلاصة:

يستخلص مما سبق أن حقن إناث الأرانب بمستوى 1 ملل من فيتامين اد$_3$ه كل 15 يوم يؤدى إلى تحسن واضح في الخصوبة (انخفاض عدد التلقيحات اللازمة للإخصاب) ،تحسن أيضا في متوسط الوزن الفردي عند مختلف الأعمار ، الزيادة اليومية في وزن الجسم ،الحيوية وذلك خلال موسمي الصيف، الخريف.