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OUTDOOR ACCESS FOR GROWING RABBITS: EFFECT OF STOCKING RATE ON BEHAVIOUR AND PERFORMANCE

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ABSTRACT

The aim of this work was to study the effects of stocking rate and outdoor access on the spatial distribution, the reactivity to a new environment, behaviour and performance of growing rabbits between 31 (D31) and 73 days of life. Two hundred and ninety nine weaned rabbits were distributed into four groups according to a 2 × 2 factorial design including the access (O group) or not (N group) to an outdoor range of 23.2 m² and the indoor stocking rate (high or low: 17 or 9 rabbits / m²; H or L groups, respectively), leading to 4 groups: OH (n=100), NH (n=99), OL (n=50) and NL (n=50). Every week, live weight and health status were checked on each rabbit. The rabbits' behaviour was assessed at D57 and D71 at 07h00, 14h00 and 19h00. Reactivity to a new environment (access to the range) was assessed during 20 min at D34, D51 and D62. Stocking rate had no effect on mortality, however outdoor access tended to increase mortality rate (7.3 vs 2.7 %, $P<0.10$). Average daily weight gain was higher in N compared to the O groups (+3.6 g/day; $P<0.001$) and L compared to H groups (+1.2 g/day; $P<0.05$). The latency time for the rabbits to access outdoor area for the first time increased with age (50 seconds at D34 against 10 min at D62; $P<0.001$), without effect of stocking rate. Regarding activity and space use, rabbits were more often active in the outdoor area than in the indoor pens (39% vs 18% at D57, $P<0.001$, and 34% vs 21% at D71, $P<0.05$). Stocking rate did not impact behaviour traits measured at D57 and D71. In conclusion, outdoor access increased the diversity of the behavioural repertoire of growing rabbits, but slightly reduced health status and growth without interaction with stocking rate.

Key words: free-range, reactivity, alternative system, behaviour, performance, *Oryctolagus cuniculus*.

INTRODUCTION

Cage housing and the deprivation of free access to an outdoor space for farm animals, is a growing societal concern among the majority of Europeans citizens (Delanoue *et al.*, 2015). However, almost all of rabbit meat in the world is produced in indoor systems and there is a lack of knowledge concerning performance and behaviour of rabbit in systems having outdoor access. The outdoor access allows the expression of specific behaviours (like running, jumping) and can reduce the level of fear compared to rabbits raised indoor (d'Agata et al., 2009) but it can impair growth performance (Pinheiro et al., 2012; Loponte et al., 2018). There is therefore a scientific challenge to understand the factors that could better balance welfare, health and animal performance in systems allowing outdoor access. We aim to study the effects of stocking rate and outdoor access on the spatial distribution, the reactivity and the performance of growing rabbits.

MATERIAL AND METHODS

The experiments received French agreement (experiment permit number 16330-2018072716211212).

Animal and experimental design

We reared 299 rabbits (INRA strain 1777) in a 30 m² mobile poultry building (SAS DI.ST.EL, 81340 Valence d'Albigeois, France; l × w × h: 5 × 6 × 2.5 m) placed on pasture, and equipped with eight 2 m² roofless pens (PARCLAP26; Chabeauti, 79330 Glénay, France; l × w: 1 × 2 m; Photo 1). At weaning (31 days of age; D31; 12th April 2019), rabbits were randomly divided into four groups according to a

2 × 2 factorial design combining (i) outdoor access (O group) or not (N group) to a 23.2 m² range area (free access from D37 to the end) and (ii) indoor stocking rate: 17 (H group) or 9 (L group) rabbits/m² obtained by placing 50 or 25 rabbits in the pens. We obtained 4 groups (2 repetitions each): OH (n = 100), NH (n = 99), OL (n = 50) and NL (n = 50) containing 50% males and 50% females each. The outdoor area was protected from predators by wire mesh, 3-wire electric fence and aviary netting. The O groups have free access to a meadow established in 2018 with a forage mix (OH-43RM, Otto Hauestein Seed SA, 13H Orbe, Switzerland) from D42. Throughout the experiment (D31-D73), the rabbits received a commercial diet formulated for growing rabbits (2 342 kcal ED/kg; 15.2 CP/kg) according to a restriction program: 85 g/kg of live weight from D32 increased 15 g/rabbit every 7 days until D71.

Photo 1: The building on pasture (left) and the pens (right)

Ambient parameters and measurements on animal and grassland areas

Temperatures inside and outside the building, the rainfall as well as wind speed were recorded daily. The grass height (a stick herbometer on 25 points along two transects per area) and the botanic composition (proportion of legumes or grasses on 8 plots of 0.25 cm² per area) were measured on the 4 outdoor areas (n=2 and 2 for OH and OL groups) at D30, D58 and D72. To estimate the plant biomass on the outdoor areas, four samples of 0.25 m² (1 m² in total) were taken at 0.5 m, 2 m, 4 m and 6 m from the exit hatch on D30 and D74. The grass was cut entirely within the plots at 2 cm height from the ground. Samples were pooled and placed in micro-perforated bags at 4°C until analysed using the EGRAN (2001) method.

Behavioural observations and reactivity evaluation

The behaviour of the animals inside the building was assessed using the scan sampling method from 10 min video recordings for each pen taken at D57 and D71 in the morning (between 7h00 and 8h00), in the afternoon (between 14h00 and 15h00) and in the evening (between 19h00 and 20h00). In parallel, a direct observation of the rabbits located on the outdoor area (OH and OL groups only) was carried out for the same duration and times. The behaviours were divided into 5 classes: inactive, active (washing, eating, drinking), positive or negative interaction (between two rabbits or more: in contact, grooming, sniffing, fighting), moving (walking, bound, race) and standing up (over hind legs with front legs raised). Reactivity to a new environment (outdoor area) was assessed at D34, D51 and D62 during 20 min before feeding according to the method of Bertrand (2002). The test consisted in measuring the latency that animals took to pass from a known environment (inside the building) to a new environment (outdoor). So that the tested rabbits never had access to the outside before the test, we used the animals of the O groups at D34, then the animals of the N groups at D51 and D62 (1 pen per group at each of these two dates). At the end, the animals in the N groups had outdoor access for a maximum of 20 minutes, either at D51 or D62, during the whole experiment.

Statistical analyses

All analyses were performed by using statistical software R version 3.4.0 (R Core Team, 2017) using outdoor access, stocking rate and interaction as fixed effects, and also day (reactivity) and/or observation time (behaviour).

RESULTS AND DISCUSSION

Throughout the experiment, the average indoor and outdoor temperature was 18.2°C (min 7.5°C and max 31.5°C) and 13.9°C (min 1.3°C and max 24.7°C). Wind speed outside averaged 2.8 m/s and rainfall was 2.4 mm (min 0 mm/d and max 24.5 mm/d). The grass height was 12 cm at the beginning of the outdoor access of animals (D37). The botanical composition of pasture was heterogeneous between the different plots as the proportion of legumes varied from 83 to 44%. The chemical composition of the meadow was 13.4% DM and 2.0, 3.8, 5.5, 2.7 and 0.7 % of Ash, CP, NDF, ADF and Lignin (DM basis). Rabbits of the OH group ravaged the meadow in about two weeks (17 days) after having access to the field whereas rabbits of the OL group needed 10 additional days to fully

consume the pasture; only some stems remained since the rabbit tended to consume first the leaves. The pasture area should be thus increased in future trials to supply sufficient grass biomass over the whole fattening period. Legendre et al. (2019) proposed access to a 0.6 m^2/day/rabbit to cover the grass intake capacity of growing rabbit.

The mortality rate from D31 to D73 reached 5%, without effect of stocking rate (P>0.05). Access to outdoor tended to increase mortality (11/150 vs 4/149 in O vs N groups, P<0.10). No interaction between outdoor access and stocking rate was observed on this parameter (P<0.05). Rabbits had good general health status throughout the experiment (98% of alive rabbits were healthy at D73) regardless of the group (NS).

Table 1: Effects of outdoor access and stocking rate on growth, mortality rate and behaviour of rabbits.

	Groups[1]					*P value*[2]	
	OL	OH	NL	NH	SEM	Outdoor access	Stocking rate
Live weight at D31 (g)	874	887	898	863	5.7	NS	NS
Live weight at D73 (g)	1967[a]	2032[a]	2136[b]	2149[b]	9.7	<0.001	0.05
Mortality (%) (nb dead/nb total)	6 (3/50)	8 (8/100)	4 (2/50)	2 (2/100)		†	NS
Inactive rabbits in the pen at D57 (%)[3]							
Morning	58.2	82.0	84.2	69.9		NS	NS
Afternoon	75.7	75.1	77.0	75.9		NS	NS
Evening	58.2	59.4	65.3	68.6		NS	NS
Inactive rabbits on pasture at D57 (%)[3]							
Morning	30.7	32.3	-	-		-	NS
Afternoon	30.6	87.3	-	-		-	NS
Evening	14.4	21.4	-	-		-	NS

[1]Outdoor access (O) or not (N); High (H) or low (L) stocking rate. [2]Interaction between outdoor access and stocking rate was not significant. [3]The effect of place (in the pen vs on pasture) on % of inactive rabbits was significant (P<0.001). [3]Data referred to the number of rabbits in each place at each time, thus the sum (% in the pen + % on pasture for each time) differed from 100%.

The live weight of rabbits was similar between groups at D31 (880 g; NS). The interaction between access and stocking rate effects on live weight and growth was not significant. At D73, the weight of the rabbits was higher in N than in O groups (P<0.001; Table 1) and L vs H groups (P<0.05). In the same way, the average daily gain between D31 and D73 was 10% higher in N than in O groups (30.1 vs 26.5 g/d, P<0.001) and was 5% higher in L vs H group (28.9 g vs 27.7 g, P<0.001) (data not reported in tables). A greater physical activity, related to the larger available space may explain this effect, since the feed intake was almost similar among groups with or without outdoor access and the nutritional contribution of grazing was almost negligible (63 vs 125 g/DM/rabbit). Such a result agree with those of Pinheiro et al. (2012) and Loponte et al. (2018).

The latency time for the rabbits to access the pasture increased with age (10 min at D62 vs. 50 sec at D34, P<0.001), with any effect of stocking rate (NS). The percentage of rabbits exit 5 min after hatch opening decreased with age (15%, 5% and 1% at D34, D51 and D62 respectively, P<0.001). This could be explained by a reduced motivation among older rabbits to explore new areas (Trocino *et al*., 2003). During the 20-min test, females were more frequently out than males at D34 (32% vs 18%), D51 (30% vs 18%) and D62 (13% vs 7%; P<0.05). The proportion of rabbits exit after 20 min of testing was lower in H than L groups (37% vs 13% at D34, 30% vs 19% at D51 and 11% vs 9% at D62, P<0.001).

Behaviour outside and inside the building (O groups only). The behaviour of rabbits was different depending on whether they were inside or outside the building: 20%, 8% or 66% vs 36%, 20% or 34% of Activity, Moving or Inactivity behaviour occurrence (in the building or outdoor for the O groups only; P<0.05). The proportion of Inactive rabbits varied along the day (67%, 51% and 38% in the afternoon, the morning and the evening at D57 and 63%, 28% and 52% at D71; P< 0.05). This may be related to the behaviour of the wild rabbit, which are more active at night, when the predation pressure is the lowest (Princz et al., 2008).

Behaviour of rabbits inside the building (comparison of O and N groups). Behaviour inside the building was affected only by the period (morning, afternoon or evening) but not by stocking rate or outdoor access (NS). A high proportion of Inactive rabbits was recorded at all observation periods on D57 (73%, 76% and 63% in the morning, afternoon and evening; $P<0.05$) and D71 (54%, 88% and 66%; $P<0.05$). Other behaviours were less frequent: Activity (17% as mean), Interaction (4%), Moving (7%) or Standing up (2%). The lack of enrichment material in the indoor pens, which generates little stimulation on animals (Luzi et al., 2003) may explain the reduced activity and interaction among animals we observed.

CONCLUSIONS

We presented here original results concerning the performance and behaviour of rabbits reared in a system allowing outdoor access or kept indoor in two contrasting densities. The system with outdoor access mixes elements of indoor system (easy feeding, watering and handling of animals, no contact with faeces in the building) and organic system (outdoor access, access to green fodder, mobile housing). Such a system enable rabbits to fulfil natural behaviours. Effects on performances and health must be confirmed by further trials. Stocking rate and/or moving of the building should be adapted to maximize pasture use and better balance the performance.

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