

# INFLUENCE OF THE DOMINANT WHITE PLUMAGE GENE ON SUSCEPTIBILITY OF FOWL TO SUBGROUP C ROUX SARCOMA VIRUS

Influence du gène du plumage blanc dominant sur la susceptibilité des poules and virus du sous-groupe C du sarcoma de Roux

Einfluss des dominanten weissen Gefiedergenes auf die Empfindlichkeit des Hühnes für die Subgruppe C des Virus des Rouxschen Sarkoms

P. K. PANI \*

## INTRODUCTION

Genetic resistance of fowl to subgroup C ROUX sarcoma virus (RSV) is controlled by a pair of autosomal alleles,  $c^s$  and  $c^r$  of the tumour virus  $c$  ( $tvc$ ) locus (PAYNE and BIGS, 1970; MOTTA *et al.*, 1973; PANI, 1973). We reported previously that black susceptible embryos ( $i^+ i^+ c^s c^s$ ) were four fold less susceptible than the white susceptibles ( $I I c^s c^s$ ) to subgroup C virus (PANI, 1974). This study reports additional information on the effect of the plumage colour genes,  $I$  and  $i^+$  on the genetic variation of pock response on the chorioallantoic membrane (CAM) of embryos to RSV.

## MATERIALS AND METHODS

*Chickens:* The highly inbred ( $F > 0.99$ ) REASEHEAT lines,  $W$  and  $R$  were used. They differ in plumage colour and susceptibility to subgroup C and are of genotypes,  $i^+ i^+ c^s c^s$  and  $I I c^s c^s$  respectively (PAYNE and BIGGS, 1970; PANI, 1974).

*Selection:* Two sublimes of males and females with black and white plumage,  $BP$  and  $WP$  respectively were developed from the  $F_3$   $W \times R$  randomly mating population of 13 sires and 104 dams. All the parents of the  $BP$  line were of  $i^+ i^+$  genotype and those of the  $WP$  line,  $I I$ . The heterozygote whites,  $Ii^+$  were eliminated from the  $WP$  line on the basis of their black flecked white plumage and when necessary by the progeny test.

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\* Houghton Poultry Research Station, Houghton, Huntingdon, PE17 2DA, United Kingdom.

The CAM response to subgroup C virus of 533  $F_7$  embryos derived from 12 sires and 68 dams of these two lines was studied. Of these parents 7 sires and 43 dams were white and produced 394 progeny.

*CAM response to virus:* A dose of 0.1 ml of RSV (RAV 49) (subgroup C) diluted to contain 100 pock forming units (*pfu*) (based on the titre of the virus stock titrated in C/0 embryos) was inoculated onto the dropped CAMs of 11-day-old chick embryos. At 19 days of incubation the pocks on CAMs were counted (DOUGHERTY *et al.*, 1960).

*Statistical analysis:* A full account of the statistical treatment of the data cannot be given in this manuscript and therefore will be restricted to the minimum necessary. By use of the least squares procedure, an analysis of variance (ANOVA) of the log transformed pock counts was performed within each plumage colour and each CAM response phenotype (resistant and susceptible). The genetic parameter, heritability ( $h^2$ ) was estimated from each ANOVA from the half- and full-sib intraclass correlation coefficients (KEMPTHORNE, 1957).

The CAM response phenotypes were recognised on the basis of the bimodal distribution of the pock counts of the combined lines (Fig. 1a) and within each plumage line (Fig. 1b). CAMs with 6 or less pock counts were considered to be resistant and those with at least 7 pocks to be susceptible.

## RESULTS

The  $h^2$  estimates of the pock response on CAMs based on the full-sib correlation for the *BP* and *WP* lines were  $0.35 \pm 0.17$  and  $0.38 \pm 0.14$  respectively with a pooled value of  $0.36 \pm 0.11$  for the whole population (ANOVA 1, Table 1). These values suggest that the trait is heritable and therefore under genetic control.

Similarly the  $h^2$  estimate for the resistant embryos was  $0.16 \pm 0.22$  and that for the susceptibles,  $0.39 \pm 0.12$  (ANOVA 2, Table 1). The effect of the plumage colour genes on the trait was highly significant ( $P < 0.01$ ) in the susceptible embryos but not in the resistants.

## DISCUSSION

It is important to note that in the susceptible population the genetic variation ( $\sigma^2_c$ ) between the  $c^s c^s$  and  $c^s c^r$  within plumage colour was much less than that between plumage colours, i.e.  $\sigma^2_c(c^s c^s, c^s c^r) \ll \sigma^2_c(c^s-II, c^s-i^+ i^+)$  because the  $h^2$  estimate of the trait computed from the sire's component of variance for the susceptibles within plumage phenotype ( $h^2_s=0.33$ ) was one half of that between plumage phenotypes ( $h^2_p=0.78$ ) (ANOVA 2, Table 1). This suggests that the association of the plumage colour genotypes, *I I* and  $i^+ i^+$  with the  $c^s c^s$  and  $c^s c^r$  genotypes is responsible for the increased genetic variation of the trait in the population. This increase may be caused by a differential expressivity of the  $c^s-i^+ i^+$  and  $c^s-II$  genotypes, which is consistent with the results reported previously (PANI, 1974). Absence of the effect of the plumage colour genes on the resistant embryos was expected because the  $c^r c^r$  cells regardless of the plumage genotypes cannot be infected by subgroup C virus. This result is in agreement

TABLE 1

MEAN SQUARES, COMPONENTS OF VARIANCE AND HERITABILITY ESTIMATES OF THE POCK RESPONSE OF CAMS TO SUBGROUP C SARCOMA VIRUS

	ANOVA 1 (Within plumage line)				ANOVA 2 (Within CAM phenotype)			
	Black		White		Resistant		Susceptible	
	<i>df</i>	<i>M. S.</i>	<i>df</i>	<i>M. S.</i>	<i>df</i>	<i>M. S.</i>	<i>df</i>	<i>M. S.</i>
Plumage ... ..	—	—	—	—	1	0.065	1	7.308
Sire/Plumage ... ..	4	0.754	6	4.367	10	0.192	10	0.689
Dam/Sire... ..	20	0.766	36	0.905	37	0.092	52	0.209
Individual/Dam... ..	114	0.353	351	0.471	84	0.096	336	0.120

	Components of variance								Heritability				
	Black		White		Resistant		Susceptible		Black	White	Resistant	Susceptible	
	$\sigma^2$	%	$\sigma^2$	%	$\sigma^2$	%	$\sigma^2$	%					
Plumage... ..	—	—	—	—	—0.003	0.00	0.044	22.80	$h^2 S$	—0.02 ± 0.21	0.43 ± 0.29	0.38 ± 0.32	0.38 ± 0.23
Sire ( <i>S</i> ) ... ..	—0.002	0.00	0.063	10.83	0.010	9.80	0.014	7.25				0.33 ± 0.29 *	0.78 ± 0.33 *
Dam ( <i>D</i> )... ..	0.076	17.86	0.048	8.23	—0.001	0.00	0.015	7.77	$h^2 S + D$	0.35 ± 0.17	0.38 ± 0.14	0.16 ± 0.22	0.39 ± 0.12
Progeny ... ..	0.353	82.53	0.471	80.94	0.096	90.20	0.120	62.18				0.14 ± 0.21 *	0.57 ± 0.16 *

\* Heritability estimates computed by combining plumage and sire components of variance ( $h^2$  in broad sense).

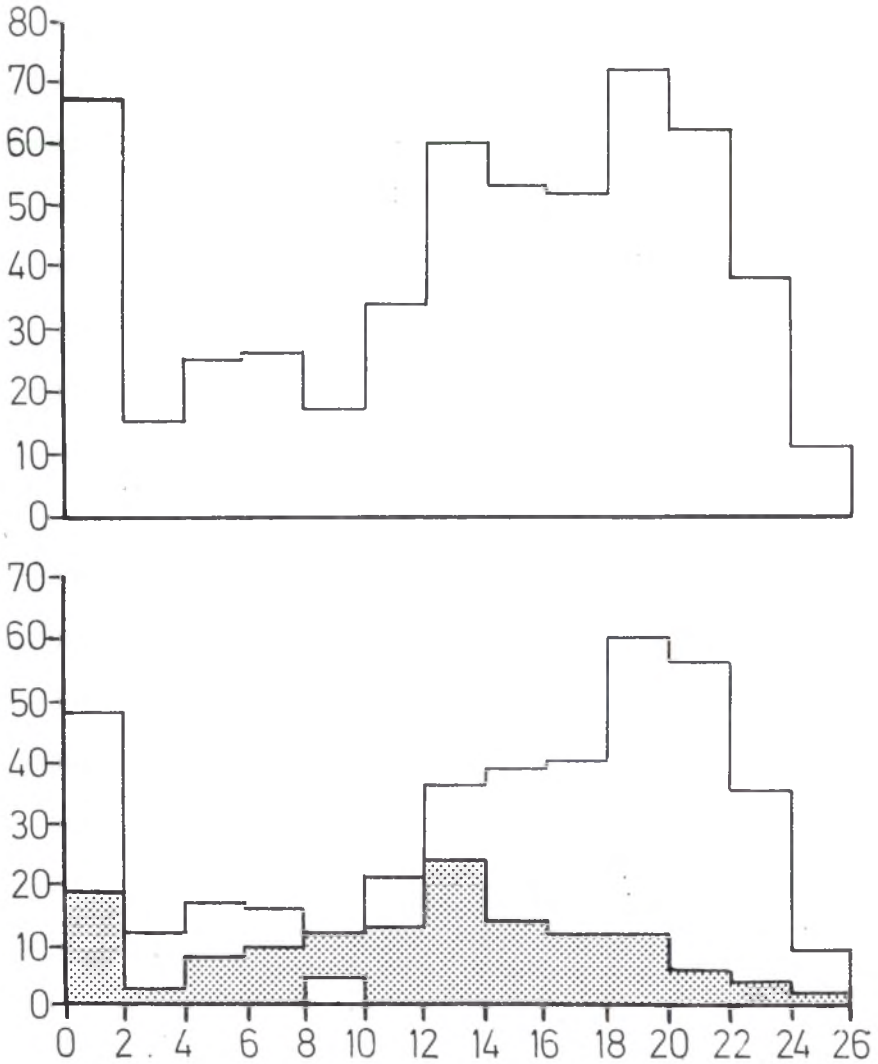


FIG. 1. Distribution of pock counts on chorioallantoic membrane of embryos; a) combined lines, b) within Cplumage line (black embryos are shaded).

with the prevailing concept that the susceptibility of host cells to sarcoma viruses is related to the presence of appropriate virus receptors on the cell surface. Possibly increase in the dose of virus to ensure infection of the  $c'c'$  cells (since the resistance to the infection is relative (Fig. 1a) might reveal the effect of the plumage genes similar to that observed in the susceptible population. This is now under investigation.

Evidence of an additive gene effect on the CAM response of embryos of the genotypes,  $c^s c^s$ ,  $c^s c^r$  was obtained from the ANOVA 1 (Table 1). The additive gene model ( $c^s c^r = 1/2 (c^s c^s + c^r c^r)$ ) was true for the *WP* line since the components of variance due to sires ( $\sigma^2_s$ ) and dams ( $\sigma^2_d$ ) were equal. On the other hand the  $\sigma^2_d$  was much greater than the  $\sigma^2_s$  in the *BP* line, suggesting lack of an additive gene effect on the CAM response in coloured embryos.

The results show that plumage colour genes may influence the response of embryos to tumour viruses and accordingly may interfere with the efficiency of the process of selecting for genetic resistance.

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#### SUMMARY

The heritability of pock response on the chorioallantoic membrane of the  $W \times R$  line chick embryos inoculated with subgroup *C* ROUX sarcoma virus was  $0.36 \pm 0.11$ . The dominant white plumage gene significantly affected the pock response in susceptible embryos but not in resistant embryos.

#### RESUME

Le taux d'hérédité du nombre de microtumeurs apparaissant sur la membrane chorioallantoïdienne d'embryons de poulets de ligne  $W \times R$ , inoculés avec le virus du sous-groupe *C* de ROUX Sarcoma, était de  $0,36 \pm 0,11$ . Le gène prédominant de plumage blanc avait un effet significatif sur la réponse de microtumeurs chez les embryons susceptibles, mais pas chez les embryons résistants.

#### ZUSAMMENFASSUNG

Die Erbllichkeit der Pockenreaktion auf der Chorioallantoismembran der mit ROUX-Sarkomvirus des Untergruppe *C* beimpften Hühner-embryos der Linie  $W \times R$  war  $0,36 \pm 0,11$ . Das dominante Gen für weißes Gefieder beeinflusste signifikant die Pockenreaktion in empfänglichen Embryos, aber nicht in resistenten Embryos.

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