

Optimizing duck (*Anas platyrhynchos*) release for weed and insect pest control under integrated rice (*Oryza sativa*) based farming system

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ABSTRACT

Rearing of ducks in rice-based farming system has multiple advantages which is not exploited due to misconception that ducks damage rice crop. This study was conducted at Agricultural College and Research Institute, Madurai during 2021 to evaluate duck release as an alternative for non-chemical weed and pest management in rice. Ducks were released in pairs of 2, 4, 6, 8, 10 and 12 in an area of 10 m² for 3 hours of stable time and were evaluated for weed density, insect counts and for reduction in beneficial insect in paddy fields. Results highlighted a definite decrease in weed and insect counts over control with weed control efficiency as high as 85.5% and insect pest control efficiency of 74.50% over control while decreased the beneficiary insect population by two-fold. Based on the results, it could be concluded that, ducks released @ 8 nos. for 10 m² for a duration of 3 h were sufficient to effectively control the weed and insect pest population during 30-40 days after transplanting in rice. Further examination is required in quantifying the optimum duck release per hectare and in situ feed available under rice + duck combination to ensure sustainable and profitable farming system.

Key Words : Rice, Duck farming, Weed control efficiency, Insect pests, Beneficiary insects

INTRODUCTION

Rice (*Oryza sativa* L.) and duck (*Anas platyrhynchos* L.) farming is a modern multispecies integrated farming system with ancient roots. Rice farmers have deployed flocks of ducks into their rice fields to help control weeds and pests which protects the environment and consumer health while improving the soil and farm viability.

Rice-duck farming is a low-cost, organic farming method with no chemical fertilisers or pesticides requirement, while 20% higher crop yields can be obtained with increase in net income on a cash cost basis by 80%. Still, in Rural Extension “Ducks are harmful to rice” is a misconception often voiced. Even though many farmers rear ducks and many grow paddy, but the opportunity to integrate has never been promoted.

Integrated Rice Duck farming has a

mutually beneficial association, and has long been appreciated for its high land productivity, and environmental and ecological benefits. With paddling, trampling, foraging, and excreting, the ducks in rice fields exert positive effects on rice production, such as decreasing the occurrence of plant diseases, pests, and weeds, enriching species diversity, and improving soil aeration, physical structure, and fertility, which together contribute to reduced inputs of chemical herbicide, pesticide, and fertilizer.

Rice-duck cultivation system has a better efficiency in comparison with typical cultivation system (Hossain *et al.*, 2005; Reddy *et al.*, 2018). Moreover, Duck’s excreta can cause enhancement in soil fertility as one gram of air-dried faeces contained 26.6 mg of total nitrogen thus reducing the usage of fertilizer in rice fields (Katsunori *et al.*, 2005). Simultaneous cultivation of rice and duck can

enhance nutrient absorption, soil nutritional improvement and proper aeration of the soil (Safriyani *et al.*, 2020).

Studies reveal that, rearing of ducks had significant effect on the weed growth and the weed seed bank diminished aggressively (Brogi *et al.*, 2015). Teng *et al.* (2016) confirmed that activities of ducks in the fields raised the status of soil nutrients and increased the activities of soil enzymes and population of nematodes, suggesting that the rice-duck integrated system was beneficial to improve soil fertility and biodiversity.

Food and Agriculture Organization of the United Nations stated that rice duck farming system proved suitable in typhoon, flood prone and even salt affected areas and also calling it a value-added livelihood enterprise as eggs supplied nutrition to the children and also an additional income of 30% over mono-cropped rice (FAO, 2013).

Integrated rice duck farming system is highly potential of increasing rice productivity up to 215% over conventional rice farming technologies, while reducing the cost of production by 30% (Pacamalan, 2016). By raising ducks on rice, no chemical fertilizers or pesticides are required, while 20% higher crop yields can be obtained and net income on a cash cost basis can increase by 80%. In addition, the labour requirements are continuous at a low level compared to conventional rice ecosystems (Salahuddin, 2005).

Based on this, a field experiment was conducted to study the effect of duck rearing in rice fields, to quantify the beneficial and non-beneficial prospects of rearing and to standardise the number of ducks rearing in rice field.

MATERIALS AND METHODS

The present investigation was conducted at Central Farm, Agricultural College and Research Institute, Madurai in rice field of 35 days old crop. The research site was located at 9° 96' N and 78° 20' E and 147 m above mean sea-level.

Duck Release

Randomly selected plots of size 10 m² (5 × 2 m) were confined with fishing nets and

ducks were released as per treatment schedule. Ducks were released @ 2, 4, 6, 8, 10 and 12 nos. and maintained in each plot for 3 to 4 hours of stable time at morning. The same was replicated 3 times at different locations on consecutive days within the same field using different birds. Observations were recorded on weed count, insect pest and beneficial insect count. Weed count was quantified using quadrats of size 1 m² (1 × 1 m) on randomly selected 3 places within the treatment. Insect pest and beneficial insect count were conducted on randomly selected plants using zig zag method. Observations on weed control efficiency (WCE), insect pest control efficiency (IPCE) and percent beneficial insect control (PBIC) were calculated using the formulas given below:

Weed Control Efficiency (%)

$$\text{WCE} = \frac{\text{Control plot} - \text{Treatment plot}}{\text{Control plot}} \times 100$$

Insect Pest Control Efficiency (%)

$$\text{IPCE} = \frac{\text{Control plot} - \text{Treatment plot}}{\text{Control plot}} \times 100$$

Percent Beneficial Insect Control (%)

$$\text{IPCE} = \frac{\text{Control plot} - \text{Treatment plot}}{\text{Control plot}} \times 100$$

The data recorded were statistically analysed under complete randomised design (CRD) using analysis of variance (ANOVA) at 5% level of significance using Star package from IRRI, Philippines.

RESULTS AND DISCUSSION

The study revealed significant changes in the weed density, insect pest count and beneficial insect reduction under rice + duck farming (Table 1).

Releasing ducks in rice fields significantly reduced weed infestations. The level of reduction was proportional to the number of ducks released in rice fields from 74.4 to 10.8 nos./m² (Table 1). Similar studies

Table 1. Effect of duck release on weed, insect pest and beneficial insects of rice

Treatment	Weed density (No./m ²)	Weed control efficiency (%)	Insect pest count (No./hill)	Insect pest control efficiency (%)	Beneficial insect count (No./hill)	Beneficial insect control (%)
Duck release @ 2 nos.	56.7	23.8	6.5	33.7	1.45	9.4
Duck release @ 4 nos.	32.3	56.6	5.4	44.9	1.30	18.8
Duck release @ 6 nos.	19.6	73.7	5.2	46.9	0.85	46.9
Duck release @ 8 nos.	11.5	84.5	4.8	51.0	0.85	46.9
Duck release @ 10 nos.	12.2	83.6	3.7	62.2	0.68	57.5
Duck release @ 12 nos.	10.8	85.5	2.5	74.5	0.70	56.3
Control (No release)	74.4	-	9.8	-	1.60	-
SEm(±)	3.4	5.7	0.40	3.45	0.10	3.48
C. D. (P=0.05)	10.2	17.4	1.22	10.5	0.29	10.6
CV (%)	18.8	17.0	12.9	13.4	15.8	17.9

conducted reveal duck rearing in rice fields reduced the weed biomass by 98% compared to rice monoculture control (Wei *et al.*, 2019), in which 84% reduction was observed due to duck disturbance only, implying that only 14% of weeds were controlled by duck grazing (Zhang *et al.*, 2009b).

Ducks have shown significant reduction of the weed infestations which was much under the economic threshold level in rice to the tune of 2.5 insects/hill while non-released plots recorded as high as 9.80 insects/hill (Table 1). Similar studies conducted have revealed that duck co-culture reduced insect pests *viz.*, Brown plant hopper, Zigzag leafhopper, Rice leaf roller, Rice stem borer, Chinese Grasshopper, Rice stem maggot and green Rice caterpillar in the paddy fields, without the need to rely on agro-chemicals (Li *et al.*, 2019) and no rice yield reduction occurred compared to conventional farming with chemical pesticide control (Zhang *et al.*, 2009a).

It was also noted that, ducks also play a negative impact in rice ecosystem by reducing the beneficial insect pests to as low as 0.70 nos./hill over conventional non release plots recorded 1.60 nos./hill (Table 1).

This study evaluated positive and negative interactions when ducks are released in rice fields. It was made evident that, duck rearing on rice field do not damage rice plant at active tillering to pre-flowering stages. Even though, the study is primitive, it confirms that ducks significantly control weeds and insect pests (green leaf hopper, brown plant hopper, leaf borer, shoot borer) but also beneficiary insects (spiders and mirid bugs).

In addition, it was observed that, weeds seed and young seedlings were only consumed

by ducks. Post release observations, noted reduced weed dominance as weed emergence took longer time which might have been due to reduction in weed seed bank on the top layer of soil.

By adopting duck rearing in rice fields can alleviate lack of labour availability during peak stages of cultivation, cost of weeding and pest management consumes 20-30% of cost of cultivation, initial soil aeration is essential for plant establishment to induce young roots in soil which is generally not prioritised, use of chemical pest control is harmful to the environment, assured returns from rice cultivation are not guaranteed which invites rice-based farming system, thereby an alternative more remunerative and eco-friendly farming system for rice is the need of the hour.

CONCLUSION

From the present study it is confirmed that, rearing of ducks on rice fields do not damage rice plants rather benefit by reducing the dependence on labour requirement for weeding and plant protection paving way towards profitable and chemical free rice cultivation. Based on the study, release of ducks @ 8 nos. per 10 m² for 3 to 4 hours was sufficient enough to effectively control weed and insect population in rice fields. However, a detailed field study has to be taken up for duck quantification per hectare, *in situ* feed availability in rice fields before releasing as a technology. It is to be considered that housing and maintaining native duck breeds doesn't require any additional cost in addition increases nutrient status of soil with reduced soil tillage making rice cultivation eco-friendly in nature.

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