

ORIGINAL ARTICLE

Effect of Ducks Present in the Rice Fields on Rice Grain Yield in Rice -Duck Cultivation

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ABSTRACT

In Order to Effect of Ducks Present in the Rice Fields on Rice Grain Yield in Rice -Duck Cultivation, in Gilan, Iran in 2013. This experiment was performed based on factorial split and it was also according to plan of randomized complete block (RCB) in three replications. In this experiment the main factor of duck was between two levels (by presence of duck and without presence of duck) and the minor factor was the factorial combination of weeding levels (weeding on the releasing day of ducks and not weeding on the releasing day of ducks); and also the planting spaces were 20×20, 25×25, 30×30 cm. The results of the analysis of variance show that the presence of duck in a rice field causes increasing in, weight of thousands grains, harvest index (HI) and grain yield. In total, results and statistics show that using duck in rice fields causes increasing in grain yield and consequently it increases farmer's income and also reduction of using agricultural pesticides and protecting the environment.

Keywords: Rice, duck, planting space, weeding, grain yield.

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INTRODUCTION

Nowadays, 75% of calories for more than two billion people in Asia, one third people in Africa and Latin America are absorbed by rice [2]. Rice in Iran also has a significant role in nutrition of people; so that the main part of the meal of people especially in the provinces of Gilan and Mazandaran contains rice [16]. One the most important problems in production of agricultural productions is weed. Weeds are main reasons in reduction of agricultural plants [12]. In recent years, health necessity in the various agricultural products in terms of remains of pesticides, chemical substances and their effects on human beings' health and the environment caused taking into consideration of new methods. In this regard, one of the methods that has been used recently as an appropriate substitution without using chemical substances and it has been environmentally friendly is organic farming which has been accepted in the world [5] and the rice-duck cultivation system became so popular in Asia and the Pacific [18] which causes improving the environment and it has a main role in reducing the effects of conventional agriculture of rice on the environment and environmental costs in production of rice [20].

Therefore, due to the increasing need of human beings to rice and environmental problems, the present experiment aims to evaluate integrated farming of rice and duck on rice yield and yield components.

MATERIALS AND METHODS

The present experiment was done in Gilan, Iran in 2013. The experiment location is as follows:

Height: 26 meters above sea level, latitude: 37 degrees 9 minutes (North), longitude : 49 degrees 45 minutes (East). This area has a mild and humid climate. Before the experiment, soil was sampled from different parts of the project area to a depth of 30 cm (table 1) in order to determine soil fertility evaluation and the amount of necessary fertilizer.

According to soil test, soil texture of test site was clay. In this study, the impact of three factors: duck, weeding, planting space in the form of split factorial based on randomized complete block design with

three replications have been evaluated. Factors tests are: Duck as the main factor in two levels of presence in rice field (D_1) and without presence in rice field (D_2), and the minor factor as the factorial combination of weeding on the duck releasing day (W_1), and not weeding on the duck releasing day (W_2); and also the planting spaces were 20×20 cm (S_1), 25×25 cm (S_2), 30×30 cm (S_3).

The number of treatments per block is 12 and it is as follows: $D_1W_1S_1$, $D_1W_1S_2$, $D_1W_1S_3$, $D_1W_2S_1$, $D_1W_2S_2$, $D_1W_2S_3$, $D_2W_1S_1$, $D_2W_1S_2$, $D_2W_1S_3$, $D_2W_2S_1$, $D_2W_2S_2$, $D_2W_2S_3$. The sizes of plots and the amount of required land according to plan and were considered 400 ducklings in each hectare. The sizes of plots were 25 square meters, and the total plots area were 900 square meters. The age of ducklings were 20 days, the time of releasing them in rice field was 20 days after transplanting in rice field and the ducklings were removed on the panicle emergence of rice. Weeding was by hand, at the end of stage was based on the plan, after that 18 ducklings were entered to rice field. In all stages of planting, from the beginning of plan to the end of plan no herbicides, pesticides or fungicides were used.

In order to analyze of data the SPSS and MSTATC software were used. For comparing data Dancken method was used, and for charting and drawing tables Word 2007 and Excel 2007 were used.

RESULTS AND DISCUSSION

Number Fertile Tiller per Hill

Variance analysis showed that to be present or not to be present of duck on land makes a significant five-percent-difference (5%) in number fertile tiller per hill. In contrast, the weeding effect on the day of releasing duck, planting space effect, interaction effect in weeding, duck interaction effect in planting space, tripartite interaction effect of duck, weeding and planting space show a significant one-percent-difference (1%), and also weeding interaction effect in planting space did not have a significant difference in terms of statistics in number fertile tiller per hill (Table 2). Average comparison confirms it, and it (average comparison) shows that number fertile tiller per treatment without duck (D_2) is 19.340, and in treatment with duck (D_1) is 16.730 in plants. Presence of duck causes 13.5% increase in number fertile tiller per hill (Table 3 and Fig. 1).

Movement and feeding activity, pecking on rice plant pie by duck may cause reduction in number fertile tiller in duck's treatments, but duck could cause increasing in absorbing required elements for plant growth; so reduction in number fertile tiller through a positive effect on other effective characteristics in yield such as grain number per panicle, filled grain per panicle, one thousand grain weight will compensate this reduction and it causes increase in yield in comparison with the treatment without duck. Wang *et al* (2004) reported that using duck on rice land has a very main role in direct feeding and rice growth increase due to good control of pests, diseases and weeds [21] Mohammadi *et al* (2013) reported that number tiller per hill in all numbers of rice had an increasing progression by duck [15]. The research results it is unlike the obtained results of [9, 14, 3, 17 and 7].

Table 1 - Analysis of soil to a depth of field testing (30-0 cm)

Soil texture	Electrical conductivity ($dS \cdot m^{-1}$)	pH	Organic carbon (%)	Total nitrogen (%)	phosphor ($mg \cdot kg^{-1}$)	Potassium ($mg \cdot kg^{-1}$)
clay	0.442	7.7	1.48	0.14	17.75	250.79

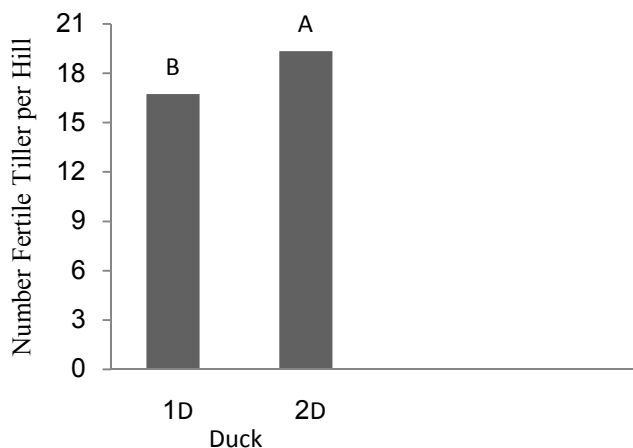


Figure 1: Means Comparison of Duck Treatment on Number Fertile Tiller per Hill

Table2- Analysis Of Variance Of Rice Yield And Yield Components In Rice- Duck System

M.s					
S.O.V	Df	Number Fertile Tiller per Hill	One Thousand Grain	Harvest Index	Grain Yield
REP	2	1.034	1.258	42.552	12596.540
DUCK	1	61.361*	5.579*	640.305*	998969.341*
ERROR A	2	2.268	0.637	30.673	143479.912
WEEDING	1	10.754**	1.156 ^{ns}	6.121 ^{ns}	125623.749 ^{ns}
DUCK × WEEDING	1	9.211**	0.451 ^{ns}	358.122**	3579037.672*
SPACING	2	212.668**	1.369 ^{ns}	74.664 ^{ns}	717813.149**
DUCK × SPACING	2	6.868**	4.849*	27.235 ^{ns}	897416.336**
WEEDING × SPACING	2	1.068 ^{ns}	3.213*	93.918 ^{ns}	498585.275**
DUCK × WEEDING × SPACING	2	58.401**	0.302 ^{ns}	296.600**	1799271.959*
ERROR	20	0.618	1.137	47.820	53529.491
C.V(%)	-	4.36	7.91	13.97	6.90

* and **: Significant at the 5% and 1% levels of probability, respectively. ns: Non- significant

Table3- Mean Comparison of Rice Yield and Yield Components in Effect Duck

S.O.V	Number Fertile Tiller per Hill	One Thousand Grain Weight (gr)	Harvest Index (%)	Grain Yield (kg.ha ⁻¹)
Duck(D ₁)	16.730 b	13.910a	52.420 a	3519.000a
Non Duck (D ₂)	19.340 a	13.050 b	46.590 b	3186.000b

Means in Each Column Followed by Similar Letter are Not Significantly Different at 5% Probability Level Using Duncan Test

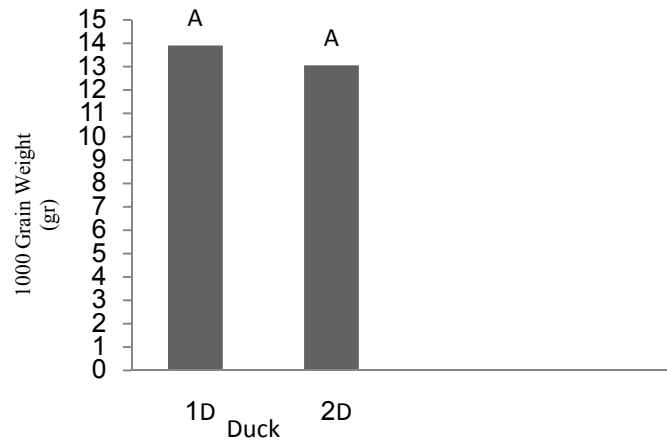


Figure 2: Means Comparison of Duck Treatment on One Thousand Grain Weight

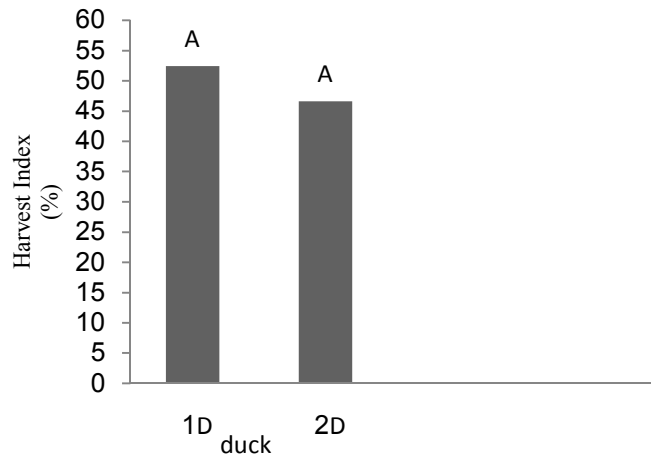


Figure 3: Means Comparison of Duck Treatment on Harvest Index

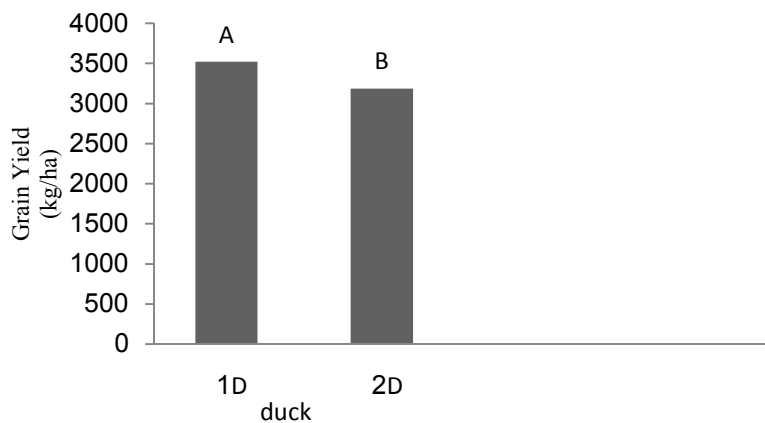


Figure 4: Means Comparison of Duck Treatment on Grain Yield

One Thousand Grain Weight

Variance analysis between duck's presence treatment and duck's absence, interaction effect in planting space, and weeding interaction effect in planting space show a significant five-percent-difference (table 2). Duck's presence causes an increase of 6.19% in one thousand grain weight in comparison with duck's absence on rice land (table 3), (fig. 2).

Duck's excreta contain macronutrients and micronutrients. Presence of micronutrients in excreta may be a factor for better growth and more photosynthesis substances. It was observed in the experiment that length and width of flag leaf in treatment by duck's presence is more than treatment by duck's absence. Flag leaf has a main role in filling of grains at the end of growth season. One of the most important components of rice yield is one thousand grain weight which is a genetic trait, and its numbers are different. It is necessary to be mentioned that its amount is affected by maturity conditions.

Karbalaei [11] reported that duck's presence causes increasing of one thousand grain weight average. Ahmad *et al* (2004) results showed that one thousand grain weight in rice-duck cultivation system is more than typical cultivation system [1]. Hossain *et al* (2004) expressed that rice-duck cultivation system causes increasing one thousand grain weight [8]. Esmaili *et al* (2006) figured out that duck's presence on rice land can cause increasing one thousand grain weight [4] which is based on the results from research.

Harvest Index

Variance analysis between duck's presence and duck's absence showed a significant five-percent-difference in harvest index (table 2). Average comparison also confirms this and it shows that the harvest index by duck's presence on rice land is 52.42%, but by duck's absence, it's 11.13% index increase (Table 3; Fig. 3).

Harvest index is calculated by this formula: $HI = (\text{Economic yield} \div \text{Biological yield}) \times 100$, but in rice is about 50%. Harvest index shows total share of produced dry matter by plant which is transmitted in grain. The more is the harvest index, it is better.

Harvest index in treatment by duck's presence is 52.42%. Duck causes economic yield increase such as filled grain and one thousand grain weight. Duck caused more produced dry matter is transmitted to grain. Harvest index is calculated by dividing grain yield (economic) to biological yield; and it is expected that quantitative yields effect on this index [4].

According to Wang *et al* (2003) report, using duck as a biological yield on rice lands has an important role due to appropriate control of density of pests and diseases; and also has an increase in grain yield (economic) numbers [20]. Results from research also confirm a significant effect of duck in harvest index.

Grain Yield

Variance analysis showed that duck's presence or absence on rice land has a significant five-percent-difference in grain yield, while planting space effect, duck interaction effect in weeding, duck interaction effect in planting space, interaction effect in weeding, tripartite interaction effect of duck, weeding and planting space showed a significant one-percent-difference (table 2). Average comparison confirmed this and it showed that the grain yield by duck's presence on rice land is 3519 kilogram in each hectare which has a ten-percent-increase in comparison with duck's absence in crop (table 3), (fig. 4).

Duck causes a ten-percent-increase in grain yield in comparison with a treatment by duck's absence. Duck could control weeds properly on rice land which could increase rice competitiveness ability, by its activity and pecking, and also by adding excreta to rice land can cause increasing of soil fertility. Pecking on rice plant pie by duck causes more oxygenating, and also by providing nutrients in rhizosphere root space causes growth stimulation and increasing yield components such as grain number per panicle, filled grain per panicle, and one thousand grain weight.

The research results of Ahmad *et al* (2004) showed that grain yield in rice-duck cultivation system was more than typical-rice cultivation system [1]. Choie *et al* [3] reported that those plots which had ducks had a better yield rather than those plots which had no ducks. Grain yield in rice-duck cultivation system was more than typical-rice cultivation system [8]. Duck has no negative effects on rice and duck's presence on rice land causes a better yield. Duck can cause mudding water, it feeds weeds, it causes increasing of more oxygenating in soil and it helps farmers in weeding rice land [17]. Islam *et al* [10] figured out that a duck can cause increasing of soil fertility.

Kang *et al* [13] reported using duck as a biological factor on rice land due to proper control of pests density and diseases can be as a significant role in grain yield of rice increasing and in this regard, pests density, diseases, weeds in crops along with rice and duck in many experiments have been proved [13].

CONCLUSION

Rice-duck cultivation system has a better efficiency in comparison with typical cultivation system. Duck's presence is an effective factor in rice yield and its components. So, duck's presence causes increasing of effective indicators in yield. Duck as a biological factor in controlling of weeds density on rice land can cause reduction or even elimination of weeds which result in increasing of rice competitive ability against weeds. Duck's excreta can cause soil fertility as a result using fertilizer on rice land is reduced. In typical rice cultivation, farmers try to reach a better yield and also try to combat pests and weeds on rice lands; they need to use chemical fertilizers and pesticides. Yet overusing chemical substances is destructive for

the environment and rice quality. Simultaneous cultivation of rice and duck can enhance nutrient absorption, soil nutritional improvement, and proper aeration of the soil. So people have a healthy life.

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