

Sunflower: A potential crop for rotating with rice in small farm setting

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Abstract

This experiment investigated the possibility of introducing sunflower (*Helianthus annuus* L.) as a rotating crop with rice to rice farmers and promoting the way in which the yield from sunflower should be utilized by these farmers in the household setting for their daily living. The field trial was conducted in the dry season of 2010 and 2011 and the field test in the farm setting was carried out in 2011. It was found that sunflower hybrid variety could be grown under low-medium input levels by the rice farmers and the seeds from this hybrid could also be collected and used for planting in the following season by these rice farmers with an acceptable yield output. However, synthetic variety was more suitable to introduce to the farmers as the seed from this variety was cheaper and the progeny seeds could be collected for replanting with an acceptable yield potential. The rice yield decreasing affected from the different factors in each farmer's fields such as pest (The fawn-colored mouse; *Mus cervicolor* and *Sclerotium rolfsii*), plot size and soil type. Seeds from harvesting could be extracted to obtain raw sunflower oil (raw sun-oil) in which sunflower meal was obtained for usage as an animal feed. The extraction process of raw sunflower oil by these farmers was primitive, requiring appropriate technical know-how to improve the quality of the oil.

Keywords: Sunflower, *Helianthus annuus*, economic sufficiency, crop rotation

1. Introduction

Chemical-intensive agricultural production (particularly an over use of chemical fertilizer) has thus been adopted to increase yield and protect the crop from insect pests and plant diseases, worsening the environmental and human health condition [1, 2]. Various efforts have been tried to introduce to the farmers the way in which agricultural practices should be adopted to mitigate the effect of this green revolution [3, 4].

Continuous practice of monoculture has been considered as an inappropriate way of production as the farmers have not fully been benefitted economically using this practice for cultivation. As a consequence, the so-called polyculture agriculture practices (such as crop rotation, multi-tiered cultivation and mixed culture) have been invented and recommended to the farmers [5-6].

In Thailand, sunflower, plant species that require less water for planting, has been cultivated in a large area in the central part of the country (particularly in Lopburi and Saraburi province), which the output of yield (0.718 ton/hectare/year) [7]. This plant has its significant to tourism as the location, where sunflower has been cultivated, has been promoted as a tourist destination, particularly when the plant has been in the flowering stage [8]. The majority of the sunflower has been grown with the hybrid seeds, introducing to the farmers by the private seed company [9].

Apart from the seed quality, growing the sunflower, however, requires an appropriate input (such as application of suitable fertilizers and pesticides as well as weed control) [10-13] as the amount of yield output of this plant has been found to subject to various agronomic management regimes [14].

One of the main beneficial features of sunflower is its oil quality. Sunflower oil is composed mainly of triacylglycerols and a small of unsaponification fraction (phospholipids, tocopherols, sterols and waxes) [15]. Sunflower oil comprised mainly of oleic and linoleic accounting for about 90 percent of the total of amino acid in seed, which they are monounsaturated- and polyunsaturated fatty acid, respectively [16]. Oleic acid is an effective hypocholesterolaemic agent [17] and, has been hailed as a potential tool in the prevention of cardiovascular disease [18]. For linoleic, the cholesterol-lowering properties have been known for many years [19]. The quality of sunflower oil is judged on the basis of the ratio oleic/linoleic acid [20]. The sunflower oil also provides an essential fatty acid (linoleic acid), and it has a low content of

palmitic acid compared with other oils (palmitic acid is believed to increase LDL-C in blood) [21].

2. Aims

This experiment investigated the possibility of introducing sunflower (*Helianthus annuus* L.) as a rotating crop with rice to rice farmers and promoting the way in which the yield from sunflower should be utilized by these farmers in the household setting for their daily living.

This experiment was conducted with the collaboration from Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan, Thailand, and Agricultural Land Reform Office, Thailand.

3. Theory, concept of the research and related findings

In Thailand, rice has been the main cash crop for the Thai farmers for a long time [22-23] and the farmers have always been the victim of adopting the continually rice cultivation. The case in point is the lower price of rice, while the cost of production (cost of fertilizers and chemical pest control agents) has been increased [24-26]. Sunflower (*Helianthus annuus* L.) has been considered as a crop with potential to recommend to the Thai farmers for cultivation as a rotating crop with rice [27]. Especially in dry season, sunflower may choose be planting for solving the problem of water deficiency for rice production.

Because of this beneficial characteristic, the commodity price of sunflower seeds is quite attractive, making it as one of another cash crop which should be introduced to the rice farmers in Thailand. However, the Thai rice farmers in general have not yet adopted this plant for cultivation as a cash crop. This may be not only because they do not familiar with the technological know-how in sunflower production but also because they do not know how to utilize the seeds of sunflower directly. With the advent of the increased oil price, promotion to increase the acreage of sunflower cultivation has been initiated by the Office of Agricultural Land Reform (ALRO), Ministry of Agricultural and Cooperatives, Thailand to address these problems. Producing sunflower and use its oil and its by-product in the household setting is also conformed to the sufficiency economy philosophy initiated by His Majesty the King of Thailand that the ALRO has promoted for this concept [28].

4. Methodology

The previous experiment showed yields of the synthetic varieties were also positively responsive to the low- and medium management input levels [29]. The synthetic varieties (Suranaree (S) 471 and S473 had high yielding similar to hybrid varieties. And, for oil content study, it was

found that the highest value of oil content was found in both in synthetic and hybrid varieties. However, the oil content in hybrids was responsive to the high management input level. Excessive application of fertilizer may affect the grain quality by decreasing its oil content [29]. From that results, this study involved transferring knowledge to the rice farmers the package of technological know-how encompassing agronomic activity in sunflower cultivation (medium input level (187.5 kg ha⁻¹ of 15-15-15 NPK fertilizer and less weed control) to oil extraction process. The field trial at two rice farm belong to the farmers (rotating with rice) was conducted to evaluate the yield of synthetic variety (S473), in which then the information was transferred to the farmers.

5. Result and Discussion

The study involved transferring knowledge to the rice farmers (rotating with rice) for the package of technological know-how, encompassing agronomic activity in sunflower cultivation to oil extraction process.

From these studies, the positive and negative aspects of sunflower as rotating cash crop to rice were revealed. In positive term, sunflower is a herbaceous crop, requiring relatively short time to obtain yield and may thus require comparatively less water for irrigation. The seed yield of sunflower in the study at farm station from previous study [29] was 2,025 kg ha⁻¹ under medium input level (187.5 kg ha⁻¹ of 15-15-15 NPK fertilizer and less weed control). However, the seed yield of sunflower of the study at farmer rice farm was very low, not over 1,125 kg ha⁻¹ because these crops were devastated by *Sclerotium rolfsii* (Figure 1) [30-32].



Figure 1 The wilt plant caused by *Sclerotium rolfsii*

On the rice field, sunflower had low germination, and the infected sunflower plants showed significant reduction of plant height, flower

disk size and wilt. Other study [32] showed that soil infested with *S. rolfsii* had a significant reduction in germination of sunflower seeds and the highest reduction in plant performance (plant length and weight). *S. rolfsii* is one of the plant pathogenic fungus causing seedling blight and damping-off in rice [33-34] as this fungus could survive in the soil and infected tissue which remained in the top soil [30, 35].

In addition to plant disease, in rice field was found the fawn-colored mouse (*Mus cervicolor*), pest in rice field, also destroy sunflower seeds since before harvesting stage (Figure 2). And the attack from *M. cervicolor* was the severe problem for sunflower seed yield decreasing at one farmer's field in this study.

Excessive water although in short time of heavy rain as a result of waterlogging (because soil texture in rice field usually as clay make it was difficult to draining after raining) also played a part in reducing sunflower stands which in turn reduced the number of plants in the plot. Both drought- and waterlogging-stressed sunflower plants showed some similarities in response in that the photosynthesis would decline which in turn would disrupt carbohydrate transport [36].

With all the data and information stated above, the farmer is equipped with the basic knowledge with respect to sunflower cultivation as a cash crop when it will be adopted to rotate with rice. Moreover, they have learnt the process of extracting oil with minimum requirement of machinery (Figure 3-6).



Figure 2 Sunflower seeds was destroy by the fawn-colored mouse (*Mus cervicolor*), pest in rice field.



Figure 3 The activity was occurring in class room.



Figure 4 Sunflower was growing in rice field.



Figure 5 The small mechanical presses for sunflower oil extraction.



Figure 6 The raw sunflower oil.

6. Conclusion

This study showed that the highest seed yield in the synthetic varieties can be obtained under all of the management input levels. Thus, the cost of utilizing the synthetic varieties for sunflower cultivation will be lower than that of the hybrids. Yields of the synthetic varieties were also positively responsive to the low- and medium management input levels.

For oil content study, it was found that the highest value of oil content was found in both in synthetic and hybrid varieties. However, the oil content in hybrids was responsive to the high management input level. Excessive application of fertilizer may affect the grain quality by decreasing its oil content.

For using sunflower as rotate crop in rice field, the farmer should realize on the affect from waterlogging and pest.

7. Recommendations

- 7.1 The rotating sunflower planting in rice field may suitable in small plot because it is easily for water draining to protect the waterlogging.
- 7.2 Direct transfer of the know-ledge (since growing the sunflower in rice field until to post-harvesting and oil extracting) when the farmers have received hand-on training has greatly enhanced the understanding and the acceptance of technological know-how in producing sunflower as a rotating crop to rice production.

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