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Efficacy of Ethanol Extract of Leftover Chili (*Capsicum annuum* var. *frutescens* L.) on Weed Control, Growth and Yield of Thai Eggplants (*Solanum xanthocarpum* Schrad. & Wendl.)

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ABSTRACT

Weeds pose major problems for farmers as they compete for essential factors for plant growth, thereby affecting crop yields. Currently, natural methods are increasingly popular for weed control. In the study area where vegetables like chili and eggplant are grown for consumption and sale, a significant weed problem in the eggplant plots led to low quality and insufficient yields. This prompted the researcher to investigate using leftover chili extract to control weeds. This study aimed to evaluate the efficacy of ethanol extracts of leftover chili in controlling weeds. The extract was prepared using a 70% ethanol solution, filtered to separate pulp, then diluted with water to a 30% alcohol concentration, and poured into a spray bottle. Three treatment groups were tested: Control Group 1 (pulling weeds by hand), Control Group 2 (spraying with 30% ethanol), and Experimental Group (spraying with chili extracts). Treatments were applied around the base of eggplant plants every 10 days for 90 days. The growth of both Thai eggplant and weeds was measured by assessing height above the soil surface, counting weed growth, and counting eggplant fruit after spraying. Statistical analyses included mean and analysis of variance. The results showed that the chili extract significantly reduced weed germination and growth (dry weight), performing comparably to manual weeding. Notably, eggplant yields in the chili extract group were the highest, significantly outperforming the ethanol control and matching manual weeding. This indicates the extract's potential for effective, chemical-free weed control that supports crop growth.

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1. Introduction

Weeds represent a formidable challenge in agriculture, directly competing with cultivated plants for essential resources such as sunlight, water, and nutrients. This competition inevitably leads to reduced crop yields and diminished quality, significantly impacting agricultural productivity and profitability (Radosevich *et al.*, 2007; Sardana *et al.*, 2017) In conventional farming, chemical herbicides are widely used for weed control; however, their persistent residues in agricultural products, potential environmental contamination, and rising costs (Tosena *et al.*, 2018) necessitate the exploration of sustainable and environmentally benign alternatives. Consequently, there is a growing global trend towards natural weed management methods, particularly crucial for the expansion of organic production systems, which strictly prohibit synthetic chemicals (IFOAM Organics International, 2024).

Chili (*Capsicum* spp.) is a vital shrub in the Solanaceae family. It is not only a staple in Asian diets and an economically significant crop in Thailand, but its fruits also contain capsaicinoids, a group of active compounds known for their pungency (Sayun and Suwanprateep, 2015). While chili fruit is primarily utilized for culinary, cosmetics, and medicinal purposes, significant amounts of leftover chili fruit often become agricultural waste, particularly in high-production areas like Thailand's central region. Despite existing research on valorizing chili waste, such

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as converting chili leaves into probiotic fermentation products (Urit, 2020), there remains a gap in research exploring in beneficial uses of discarded chili fruits.

The inherent properties of capsaicinoids suggest their potential as a natural bio pesticide. Previous studies have demonstrated the efficacy of chili extracts in controlling various insect pest like aphids and beetles by causing cellular irritation (Jirapong, 1999) and even inhibiting bacterial growth in laboratory settings (Soiklom *et al*., 2013). While these studies primarily focused on pests and bacteria, the fundamental irritant and cellular disruption properties of capsaicinoids suggest a plausible mechanism for inhibiting plant cell functions, which could extend the weed seed germination and growth. Specifically, capsaicinoids are polar hydrocarbons that readily dissolve in alcohol, ether, and acetone rather than in water (Salzer, 1997). This characteristic indicates that an ethanol-based extraction would be more effective in isolating these active compounds, potentially yielding a higher concentration of capsaicinoids compared to water-based extracts. Moreover, ethanol itself can contribute to weed control by inducing cellular dehydration in plants, a mechanism observed in other alcohol-containing natural weed suppressants (Sila-on, 2021; Nicholson, 2022).

In the study area, local farmers cultivating Thai eggplant (*Solanum xanthocarpum* Schrad. & Wendl.) for consumption and sale face a persistent challenge from common weeds like barnyard grass (*Echinochloa crus-galli* (L.) P.Beauv.) and sensitive plant (*Mimosa pudica* L.). These weeds severely impede eggplant production, leading to reduced yields and unprofitability, despite recommendations for pre-emergence weed control combined with manual weeding or mulching (Kongsaengdao *et al.,* 2010). Given the escalating costs of synthetic herbicides and the increasing demand for organic and chemical-free produce, exploring effective and accessible natural alternatives is paramount for supporting local farmers and promoting sustainable agricultural practices.

Therefore, this research aimed to investigate the potential of utilizing leftover bird's eye chili (*Capsicum annuum* var. *frutescens* L.) extract as a natural weed control agent for eggplant cultivation. Specifically, the objectives of this study were to: 1) evaluate the efficacy of ethanol extract of leftover chili in inhibiting weed seed germination in an eggplant plot; and 2) assess its impact on the growth and yield of Thai eggplant, aiming to provide farmers with a cost-effective, environmentally friendly, and easily implementable weed management solution that aligns with organic production principles.

2. Materials and Methods

2.1 Plant Material and Extract Preparation

Fresh, bright red or orange, leftover bird's eye chili fruits harvested within 48 hours, were collected from the study area in Krachaeng Subdistrict, Bang Sai District, Phra Nakhon Si Ayuttaya Province, Thailand during May 2023. The chili fruits were washed thoroughly with clean water, had their stems removed, and were then stored at room temperature.

For extract preparation, 200 grams of chili fruits were finely chopped into small pieces, approximately 1 cm cube. While grinding the chili into a paste might potentially yield a more concentrated extract by increasing the surface area for solvent interaction, this study opted for chopping to simplify the extraction process, making it more accessible for farmers to replicate without specialized equipment. The chopped chili samples were then subjected to a maceration process, adapted from methods described by Preedapattarapong (1994), Kaewnoi *et al*. (2018), and Saeung and Punya (2022). Specifically, 200 grams of the chopped chili were soaked in 1000 mL of 70% ethanol at room temperature (25-30°C) for 24-72 hours.

Following the maceration, the mixture was filtered using fine-mesh cloth to separate the solid chili residue. From the resulting filtrate, 430 mL was diluted in 570 mL of distilled water to achieve a final concentration of 30% (v/v) alcohol. This specific alcohol concentration was selected based on preliminary trials and the adapted review literature above suggesting that a 30% ethanol solution provides an optimal balance between efficient extraction of capsaicinoids, which are alcohol-soluble, and a sufficient level of alcohol-induced dehydration for effective weed control, while minimizing potential phytotoxic to the target crop. The diluted solution was left to stand for 15 minutes at room temperature to ensure thorough mixing. The physical characteristics of the prepared chili extract, including color, clarity or separation, and smell, were observed, and its pH value was measured before storage in a spray bottle for subsequent efficacy evaluation.

2.2 Effect of Chili Extract on Weed Control, Growth, and Yield of Thai Eggplant

This study was conducted as a pot experiment under ambient conditions, utilizing a Completely Randomized Design (CRD). To ensure statistical validity, five replicates were used for each of the three treatment groups, with one pot representing each experimental unit.

2.2.1 Pot Preparation and Plant Establishment

Each experimental unit consisted of a plastic pot with a diameter of 20 cm and a height of 25 cm, filled with a pre-sterilized potting soil. The soil was screened to remove pre-existing weed seeds and contaminants, ensuring consistency across all pots. Thirty-day-old Thai eggplant seedlings were transplanted, one per pot. Immediately after transplanting, weed seeds of barnyard grass (*Echinochola crus-galli* (L.) P.Beauv.) and sensitive plants (*Mimosa pudica* L.) were intentionally sown into each pot at a density of 5 seeds per weed species, ensuring a controlled and consistent weed challenge. Plants were consistently watered every three days to maintain adequate soil moisture (Adapted from Pinsupa and Nakhon Si, 2010).

2.2.2 Experimental Treatments

The three treatment groups were as follows:

1. Control group 1 (Manual weeding): Weeds were removed by hand-pulling every 10 days to serve as a positive control representing traditional, non-chemical weed management.

2. Control group 2 (30% ethanol): Pots were sprayed with 10 mL of 30% ethanol solution without chili extract.

3. Experimental group (Chili extract in 30% ethanol): Pots were sprayed with 10 mL of the prepared chili extract (in 30% ethanol) every 10 days.

2.2.3 Application Method

For spray treatment (Groups 2 and 3), the 10 mL solution was applied using a fine-mist spray bottle, targeting the weeds growing around the base of the eggplant plants. Care was taken to minimize direct spraying onto the eggplant foliage to assess the selective nature of the extract. Applications were carried out every 10 days for a total duration of 90 days.

2.2.4 Data Collection and Measurements:

1) Weed germination and growth: The number of newly grown weeds, or germinated weeds, was counted and recorded every 10 days. At 30 days after initial weed planting, the dry weight of weed stems (barnyard grass and sensitive plants) was measured by carefully excising the weeds at the soil surface, drying them in an oven at 60°C for 48 hours, and then weighing.

2) Eggplant growth and yield: The height of Thai eggplant, measured from the soil surface to the highest growing point, was recorded every 10 days. The number of eggplant fruits was counted during the harvest, which commenced 60 days after transplanting and continued until 90 days. The percentage of fruit set after flower bloom could not be accurately assessed in this experimental setup; thus, the total fruit count per plant served as the primary yield indicator.

2.2.5 Comparison with Chemical Herbicides:

This study intentionally focused on evaluating the efficacy of a natural, plant-based extract as a sustainable and organic alternative to conventional herbicides. While chemical herbicides are widely used, direct comparison was omitted to specifically highlight the potential of the chili extract within an organic or reduced-chemical farming context. The manual weeding control (Group 1) served as a practical benchmark for comparison, representing a common and effective non-chemical weed control method often employed by organic farmers. The primary goal was to find a bio-alternative that could potentially reduce the labor intensity of manual weeding and mitigate the environmental concerns associated with synthetic chemicals.

2.3 Statistical Analysis

All collected data were subjected to Analysis of Variance (ANOVA) to determine significant differences among treatment groups. When a significant F-test result was obtained ($p < 0.05$), the means of treatments were further compared using the Least Significant Difference (LSD) test at the 0.05 probability level. All statistical analyses were conducted using SAS statistical software.

3. Results and Discussion

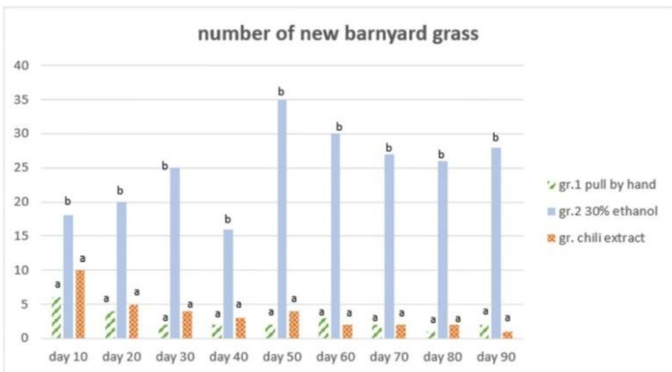
3.1 Characteristics of Chili Extract

The chili extract prepared in this study was observed to be a homogeneous, bright orange-red solution, as shown in Figure 1, with a distinctive pungent chili odor, indicating no phase separation. Its pH value was measured at 6.04 ± 0.05, which is notably close to the pH of pure capsaicinoids solution (5.90 ± 0.03), as reported by Kaewnoi *et al.* (2018). These physicochemical properties confirm that the extraction method successfully yielded an extract with characteristics appropriate for the study, suggesting a stable and consistent formulation. The similarity in pH indicates that the active compounds, primarily capsaicinoids, were effectively extracted and retained their inherent acidic properties.

3.2 Effect of Chili Extract on Weed Germination and Growth

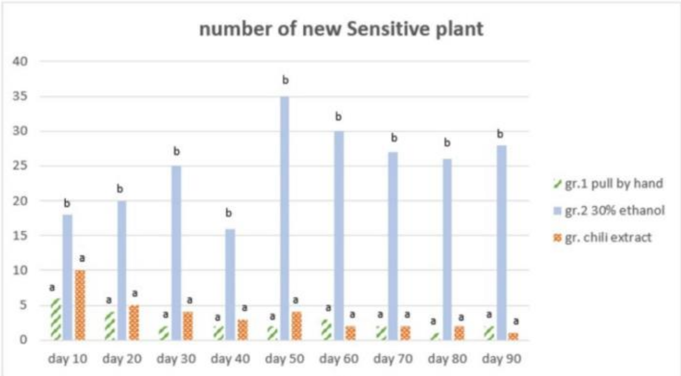
The efficacy of chili extract in controlling weed populations was evaluated over a 90-day period. Figure 2 illustrates the dynamic changes in the number of newly germinated weeds for both barnyard grass and sensitive plant across the experimental groups.

Figure 1 The homogeneous chili extract used in this research after 24 hours maceration



(a)

Figure 2 Effect of chili extract on the number of new germinated weeds: (a) barnyard grass and (b) sensitive plant The x-axis is time(day), and y-axis is number of new weeds (plants/area)



(b)

Figure 2 (Continuous)

As depicted in Figure 2, the application of chili extract significantly suppressed the germination and subsequent emergence of new weed seedlings for both barnyard grass and sensitive plant, particularly becoming evident from 20-day post-application onwards. The rate of new weed emergence in the chili extract group was markedly lower compared to the 30% ethanol-only group (Control Group 2). Importantly, the effectiveness of the chili extract treatment in reducing new weed germination was comparable to that achieved by manual weeding (Control Group 1), indicating its strong potential as a natural alternative to labor-intensive physical removal.

Further assessment of weed control focused on dry weight of weed stems at 30 days of age, as presented in Table 1.

Table 1 Effect of chili extract on dry weight of weed stem at 30 days of age

Treatment	**Dried weight of Barnyard grass** (mean±S.D., mg/Area)[1]	**Dried weight of sensitive plant** (mean±S.D., mg/Area)[1]
Pulling weeds by hand	N/A	N/A
30% ethanol	128.25±0.52b	95.52±0.41b
Chili extract	55.00±0.10a	11.00±0.19a
F-test	*	**
C.V. (%)	36.09	21.77

1 : Means followed by different letters in the same column are significantly different by LSD.

* = significant at $p < 0.05$

** = significant at $p < 0.01$

Note: N/A (Not applicable) for the “Pulling weeds by hand” group indicates the weeds were physically removed, hence no dry weight data was collected for comparative analysis of growth in this specific measurement.

Table 1 clearly illustrates that the chili extract significantly reduced the dry weight of weed stems for both barnyard grass and sensitive plant when compared to the 30% ethanol control. For barnyard grass, the dry weight decreased from 128.25 mg to 55.00 mg per stem, while for sensitive plant, it dropped from 95.52 mg to a remarkable 11.00 mg per stem. This substantial reduction in biomass further confirms the potent inhibitory effect of the chili extract on weed growth. The observed efficacy aligns with findings from other studies demonstrating that crude plant extracts, in both water and methanol, can inhibit weed growth and biomass accumulation (Sukkhang *et al.*, 2019); tamarind, lemongrass, and citronella grass extracts can inhibit Minnie root growth and dried weight. Furthermore, the properties of the chili extract in this study, which yielded a slightly weaker acid compared to standard capsaicinoids but retained its efficacy in an alcoholic solution, are consistent with the research by Mensin *et al.* (2021), which found that mixed peppermint extracts in alcohol could effectively inhibit goose grass germination. This suggests that the combination of active capsaicinoids and the ethanol solvent create a potent bio herbicidal action.

3.3 Effect of Chili extract on Thai Eggplant growth and Yield

The impact of chili extract application on the growth and yield of Thai eggplant was also critically assessed. Table 2 presents the summary of eggplant height and fruit yield across the treatment groups.

Table 2 Effect of chili extract on growth and yield of Thai eggplant

Treatment	**Plant height** (mean±SD, cm)[1]	**Number of fruit/plant** (mean±SD)[1]
Pulling weeds by hand	17.87±0.22b	5.25±0.30b
30% ethanol	10.59±0.20a	0.00±0.00a
Chili extract	16.48±0.63b	4.15±0.08b
F-test	*	*
C.V. (%)	5.71	1.93

1 : Means followed by different letters in the same column are significantly different by LSD.

* = significant at $p < 0.05$

As shown in Table 2, eggplant plants in the chili extract experimental group exhibited significantly higher average height (16.48 cm) compared to the 30% ethanol-only group (10.59 cm). Notably, the height achieved in the chili extract group was statistically comparable to that of the manual weeding control group (17.87 cm). This indicates that the chili extract did not negatively impact eggplant vegetative growth.

Moreover, the fruiting performance of eggplant was profoundly affected by the treatments. In the chili extract group (group 3), eggplant plants produced a substantial number of fruits, with an average of 4 fruits per plant harvested between 60 and 90 days after planting. This yield was significantly higher than the 30% ethanol-only group (group 2), where plants produced no collectible fruits, and many flowers aborted or failed to bloom.

Crucially, the fruit yield in the chili extract group was statistically comparable to that of the manual weeding control group (Group 1).

The observed beneficial effect on eggplant growth and yield, coupled with effective weed control, can be attributed to the properties of the chili extract and its solvent. Ethanol, as a solvent for chili extract, serves a dual purpose. Firstly, its polarity is congruent with capsaicinoids, facilitating the extraction of a high concentration of these active compounds. As discussed, these capsaicinoids, even in a slightly less acidic form than pure capsaicinoids, contribute to weed inhibition. Secondly, ethanol acts as a dehydrating agent, drawing water out of plant cells. This mechanism is particularly effective against tender weed cells, leading to their inhibition or death, similar to how fermented water containing alcohol and acid can control weeds in cassava fields without harming the main crop (Sila-on, 2021). This effect on weeds, combined with the normal growth of eggplant, suggests a degree of selectivity or a rapid degradation of the extract's phytotoxic effect on the more established crop. While previous research (Poonpiboonpipat and Wachoo, 2020) suggests that weak acid extracts may not offer permanent weed control and re-infestation can occur if weeds receive sufficient water, the integration of chili extract provides a promising approach that minimizes reliance on manual labor and harmful chemicals, without compromising crop yield.

4. Conclusion

This study definitely demonstrated the efficacy of using ethanol extract of leftover chili as an effective natural herbicide. The findings revealed that this ethanol extract of leftover chili significantly suppressed the germination and subsequent growth of key weeds like barnyard grass and sensitive plants. Quantitative analysis showed a remarkable reduction in weed dry weight, with barnyard grass decreasing from 128.25 to 55 milligrams per stem and sensitive plants from 95.52 to 11 milligrams per stem, when compared to the ethanol-only control group. Crucially, the weed control achieved through the ethanol extract application was comparable to that of laborious manual weeding, a traditional and time-consuming method.

Beyond just weed suppression, the research also confirmed the safety and beneficial impact of the ethanol extract of leftover chili on the main crop. Eggplant plants treated with the ethanol extract of leftover chili exhibited normal and even superior growth, demonstrating the highest average height and yielding more flowers and fruits. Specifically, eggplants in the experimental group produced an average of four fruits per plant, a yield significantly higher than the ethanol-only group and not statistically different from the manually weeded control group. This positive outcome on crop yield, coupled with effective weed control, highlights the extract's potential as a selective herbicide that targets weeds without harming the desired crop.

These findings strongly suggest that the ethanol extract of leftover chili presents a variable and environmentally friendly alternative for weed control. It is particularly suitable for pre-planting weed control in agricultural plots, preparing the ground for optimal crop growth. Furthermore, for post-emergence weed control in established crops or seedlings, the targeted application of the ethanol extract of leftover chili directly onto weeds, while carefully avoiding contact with the main plants, can effectively control or reduce weed proliferation. The use of ethanol as a solvent facilitated the extraction of potent capsaicinoids and contributed to the weed suppression mechanism by dehydrating plant cells, a process consistent with observation from other alcohol-containing natural herbicides (Sila-on, 2021).

While this study offers compelling evidence for the effectiveness of ethanol extract of leftover chili as a natural weed control agent, its application needs further validation. Therefore, comprehensive testing in larger, diverse agricultural settings and under varying environmental conditions in highly recommended before its widespread adoption by farmers. This will ensure its consistent efficacy and practicality, paving the way for a sustainable and chemical-free approach to weed control in modern agriculture.

5. References

IFOAM Organics International. 2024. **The Principle of Health.** Available Source: https://www. ifoam.bio/why-organic/principles-organic-agriculture/principle-health, June 23, 2025.

Jirapong, L. 1999. **Preparation and Use of Herbal Plant for Pests Control.** Institute for the Promotion of Organic Agriculture and Farmer Schools, Department of Agricultural Extension, Bangkok. (in Thai)

Kaewnoi, A., Manok, S., Duanyai, S. and Hongprom, Y. 2018. Development of Capsaicin Extract from Rangsima Chili for Use in Making Chili Gel Product. **Chalermkanjana Academic Journal** 5(1): 48-54. (in Thai)

Kongsaengdao, S., Sukprasit, A. and Kongjiang, K. 2010. **Weed Control in Eggplant.** Experimental Report. Weed Research Group, Plant Protection Research and Development Office and Horticultural Research Center, Kanchanaburi. (in Thai)

Mensin, S., Boonkhan, W., Burutpakdi, W. and Promsorn, W. 2021. **Research Report on Biological and Substitute for Agricultural Chemicals for Cultivation of Environmentally Friendly Plants of High Areas.** High Area Research and Development Institute (Public Organization). (in Thai)

Nicholson, J. 2022. **The Effect of Alcohol on Plants.** Available Source: https://sciencing.com/ effect-alcohol-plants-8006187.html, August 30, 2024.

Pinsupa, J. and Nakhon Si, K. 2010. **Research Report on Research and Development of Substances from the Wild Spikenard for Weeds Prevention and Elimination.** Department of Agriculture (DOA). (in Thai)

Poonpiboonpipat, T. and Wachoo, M. 2020. The Efficiency of Certain Types of Weeding Substances on the Control of Nut Grass and Toxicity to Corn. **Journal of Agriculture Naresuan** 17(1): 48-57. (in Thai)

Preedapatarapong, N. 1994. **Production of Oleoresin and Oil Plant from Chili.** Graduate School, Kasetsart University, Bangkok. (in Thai)

Radosevich, S., Holt, J. and Ghersa, C. 2007. **Ecology of Weeds and Invasive Plants: Relationship to Agriculture and Natural Resource Management.** Wiley, New York.

Saeung, P. and Punya, N. 2022. Effects of *Ocimum canum* SIMS. Extract on Seed Germination and Growth of Plants. **Journal of Research and Development, Valaya Alongkorn Rajabhat University under the Royal Patronage (Science and Technology)** 17(2): 61-71. (in Thai)

Salzer, U.J. 1977. The analysis of Essential Oils and Extracts (Oleoresin) from Seasonings – a Critical Review. **CRC Critical Review in Food Science and Nutrition** 9(4): 345-373.

Sardana, V., Mahajan, G., Jabran, K. and Chauhan, B.S. 2017. Role of Competition in Managing Weeds. **Crop Protection** 95(Special Issue): 1-7.

Sayan, P. and Suwanprateep, S. 2015. **Research Report on Analysis of Capsaicin Content in Chili by Fourier Transform Infrared Spectroscopy.** Rajamangala University of Technology Suvarnabhumi. (in Thai)

Sila-on, P. 2021. Wisdom of the land | Bio-extract for grass knock out. **Golden Jubilee Museum of Agriculture.** Available source: http://www.youtube.com/watch?v=asGtUQ-sldc, October 28, 2021. (in Thai)

Soiklom, S., Prommais, P. and Klinchan, S. 2013. Efficiency of Pepper Extracts with Anti-bacterial Activity, pp. 286-291. *In* **Proceedings of the 51st Kasetsart University Annual Conference: Plant Science.** Kasetsart University, Bangkok. (in Thai)

Sukkhang, S., Promdaeng, S., Saejiew, A. and Suwanwong, S. 2019. Crude Extracts from Tamarind Shells (*Tamarindus indica* L.), Lemon Grass (*Cymbopogon citratus* Stapf.) and Citronella Grass (*Cymbopogon nardus* Rendle.) Inhibit Germination and Growth of Minnieroot (*Ruellia tuberosa* Linn.). **Agricultural Science and Management** 2(3): 29-36. (in Thai)

Tosena, K., Thumsaen, B., Songsri, P. and Konkhamdee, S. 2018. Growth Inhibitors of Some Weeds and Crops by Using Wood Vinegar in Combination with Pre-Emergence Herbicides. **Kaen Kaset Journal** 46(5): 901-910. (in Thai)

Urit, T. 2020. **Research Report on Adding Value to Organic Pepper Leaves from Agricultural Waste into Commercial Prebiotic Herbal Fermentation Products.** Naresuan University. (in Thai)