



RASPBERRY PRODUCTION GUIDE FOR WYOMING

Cane fruits include a number of species including raspberries, blackberries, boysenberries, Marionberries, Loganberries and Tayberries. Cane fruit production in Wyoming is limited mainly to everbearing, summer-bearing and fall-bearing red and yellow raspberries that produce fruit on primocanes. Other cane fruit including most blackberries, black raspberries, purple raspberries, Boysenberries, Marionberries and Loganberries are not reliably cold-hardy plants for Wyoming growers. There are, however, many varieties of red and yellow raspberries that thrive and produce reliable yields for many years.

GROWING CONDITIONS

Raspberry plantings may last for 15 or more years, so careful consideration of where to locate these plants is time well invested. When selecting a location, keep

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RASPBERRY VARIETIES FOR WYOMING

		USDA Hardiness Zone
Red Summer-Bearing	Boyne	3
	Canby	3
	Latham	4
	Liberty	3
	Nordic	4
	Prelude	4
Red Fall-Bearing	Amity	3
	Autumn Bliss	4
	Caroline	4
	Crimson Giant	4
	Heritage	4
	Himbo Top	4
	Joan J	4
	Polana	3
	Redwing	4
	September	3
Yellow Fall-Bearing	Anne	4
	Fall Gold	4
	Double Gold	4

in mind that raspberry plants prefer full sun, and organic-rich soils with regular water and fertilizer applications throughout the growing season. Common causes of unproductive raspberry plantings include lack of adequate sun, nutrition and moisture.

The plant's spreading root system survives for many years sending up canes each spring. Those canes are biennial, meaning they can live for two years in ideal growing conditions, but it is recommended for most Wyoming producers to treat canes as annuals and cut them to the ground at the end of each growing season. First-year canes are called primocanes and second-year canes are called floricanes. The most reliable raspberries for Wyoming growers are those that produce fruit on primocanes. These are often called everbearing, summer-bearing and fall-bearing raspberries. (See table below.) Most blackberries and other cane fruits produce fruit only on floricanes, so growers must keep those canes alive for two seasons before a crop is harvested. Extremely cold temperatures and drying winds can kill overwintering primocanes and therefore floricanes may not develop in Wyoming. Additionally, in colder areas of Wyoming it is not uncommon for an early fall freeze to prevent fruit ripening of fall-bearing varieties. Summer-bearing varieties that produce in July, August and September are the most reliable producers.

PLANTING AND CARE

Prior to planting growers can amend soil with compost to increase organic matter content of the soil. Dormant bareroot plants can then be planted as soon as the soil can be worked. Transplant actively growing container plants after the risk of snow and freezing temperatures has passed. Space plants 3-5 feet apart in rows with 6-8 feet between rows. Hand-water immediately after planting, then install a drip irrigation system for the most efficient irrigation. Install two drip lines 12 inches apart the length of the row with plants in between drip lines. Water new plantings daily, gradually cutting back to 2-3 times per week. Regular watering is required for establishing new plantings and during fruit development and ripening. Drip irrigation is ideal for raspberry plants because water is directed at the root zone and it keeps water off

the foliage, thus avoiding foliar diseases. Drip irrigation should be installed before the planting is mulched so water drips directly into the soil. Apply mulch 2-4 inches thick throughout the entire planting to help the soil conserve moisture and to suppress weeds. During the first growing season focus on establishing a healthy planting and expect to harvest only a small amount of fruit. Second year and beyond, yields can be productive.

For most places in Wyoming, treat summer-bearing and fall-bearing raspberry canes as annuals. In spring, allow new canes to emerge from the ground. Those canes grow vegetatively before flowering in late summer-fall. Begin harvesting fruit when ripe and continue harvesting until end of growing season. Once plants have gone dormant in fall (usually after the first hard freeze) prune primocanes to the ground. In spring as temperatures warm, new canes emerge each year. Repeat the process every year.

In Wyoming's lowest elevations, growers may be able to get a second yield from their raspberry canes by leaving primocanes to overwinter. Primocanes left to overwinter



Hand water immediately after planting. Use drip irrigation every day or every other day through first growing season to help new plants establish.

should be trained to a trellis to keep them upright. The canes that survive become floricanes and produce flowers and fruit low on the cane before the newly emerged primocanes flower and produce fruit.

HARVESTING

When fruit begins to ripen, harvest 2-3 times a week to ensure fruit is picked at peak ripeness. To improve shelf life and to prevent storage diseases, avoid harvesting berries when wet. Growers can quickly learn to recognize the color and firmness of a ripe raspberry, depending on varietal characteristics. Continue to harvest through the first hard freeze. Place berries in shallow containers and refrigerate or process quickly after harvest.

DISEASES AND DISORDERS OF RASPBERRY

Physiological disorders (abiotic disorders)

Sunscald or tip burn

The clear sunny skies typical of Wyoming in the summer can result in sun damage in the form of sunburn. Symptoms include yellow or browned leaves on tissue exposed to unfiltered intense sunlight. Affected fruit may appear white in spots, especially on side with most sun exposure. To manage, protect plants from intense sun with a temporary shade cloth.

Wind injury

Injury from wind in Wyoming includes leaning plants, broken canes and wind-burned foliage. To reduce wind effects, adequately tamp soil down around roots along with adequate watering at planting to ensure good contact of roots with the soil. This helps to avoid plant movement and possible injury and uprooting during wind events. For small plantings, construct a trellis to help support an upright growth of canes which would avoid breakage issues. Remove wind burned or damage tissue to promote healthy, new growth.

INFECTIOUS DISEASES

Foliar diseases

Powdery mildew

Powdery mildew is a fungal disease that overwinters in cane tips and buds and emerges during humid and cool to warm weather periods during the growing season. Symptoms are a whitish-grey powdery mold-like growth or felt-like patches on leaves, buds and canes. Leaves may crinkle and curl upwards. Manage with disposal of infected tissue to reduce inoculum and prune to improve airflow if stand is overcrowded. Fungicides are successful if applied at first signs of disease.

Raspberry anthracnose

Raspberry anthracnose is a fungal disease that can affect both black and red varieties. Symptoms can appear on canes, leaves, and sometimes fruits at any time of the season but typically follow periods of cool wet weather. Most commonly, symptoms on stems appear as scattered small, roundish purple spots (often about $\frac{3}{8}$ inch in diameter). Overtime spots can merge and girdle the canes resulting in cane death. Mature stem lesions develop ashen-colored, sunken centers with raised purple margins. Lesions on leaves are smaller ($\frac{1}{8}$ inch) and more irregularly shaped, and over time enlarge and develop grey centers with a reddish-purple border. These centers may fall out, giving the spots a “shot-hole” effect.



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Cane blight

Whole plant and root diseases

Cane blight

Cane blight (pictured below) is caused by the fungus *Kalmusia coniothyrium* (formerly *Leptosphaeria coniothyrium*). This fungus overwinters on old cane stubs and near wounds on infected fruiting canes. This pathogen is a wound invader, so it is rarely a problem in hand-harvested fields. Symptoms of cane blight usually appear in the early summer after blossoming and leaf emergence, in association with wounds (by pruning or harvesting) caused the previous year. Look for dark brown to purple cankers on the canes and tissue death above if the cankers encircle the cane. In wet weather, the black specks (fungal fruiting bodies) in the cankers will ooze spores that when dried gives the canker a silvery appearance. Infected canes are often brittle and snap off in windy conditions. To manage, adjust irrigation to avoid wet plants for long periods. Avoid over-fertilization, as this leads to succulent new growth that is more prone to breakage and wounding by insects. Control insect pests that can cause wounds. Sanitation is very important. Remove and destroy diseased primocanes and spent floricanes in the dormant season and disinfect pruning tools between cuts (30 seconds in 10 percent bleach or 70 percent alcohol).

Fire blight

Fire blight (pictured below) is caused by the bacterium *Erwinia amylovora*. This bacterium infects many species in the rose family and is especially a problem in apple, pear, quince and crabapple. However, all strains of the bacterium do not infect all species of the rose family. For example,



Brian Olson, Oklahoma State University, Bugwood.org

Fire blight

the bacterium strain that infects raspberry does not infect apples, and the apple strain does not infect raspberry. The exception is “Boyne” raspberries, which can be infected by the apple strain. The most prevalent symptom is that infected cane tips become blackened, die and resemble a “shepherd’s crook”. Under high humidity, cream-colored bacterial ooze may appear on infected canes. Infection continues down the cane and leaves may wither and die. Infected fruit will not mature and will become brown and dry up. Disease favors new growth and is transmitted by rain, wind and insects. Management is mostly through preventative measures. Plant only certified disease-free plants. Remove and destroy infected canes as soon as you see them. Prune cuts should be 8-12 inches below visibly diseased tissue and disinfect pruning tools after each cut (see above). Avoid over-fertilization as vigorous, succulent tissue is most susceptible.

Verticillium wilt

Verticillium wilt, a fungal disease caused by *Verticillium dahlia*, is mostly a problem on black raspberry and rarely found in red raspberries. New canes wilt in mid-summer and bluish stripes of infected tissue may extend up the canes from the ground. Foliage can take on a scorched appearance and leaf blades drop leaving the petioles still attached. Initially, only part of plant may be affected and as the disease progresses the whole clump may die. Once plants are infected, nothing can be done. Since this disease is very difficult to eradicate once introduced into the field, prevention of establishment and movement are the best defenses. These would include; removal of infected plants and neighboring plants to reduce spread, and care to avoid

tracking soil from infested areas to clean areas. In extreme cases of infested fields there are preplant soil fumigation products available, but they are costly and require special application equipment.

COMMON REGIONAL PESTS OF THE CANES, CROWNS, AND ROOTS

Raspberry crown borer

Insect borers cause damage in very vital plant tissues as compared to insects that eat just the leaves. Borer damage is much more likely to kill the plants. The raspberry crown borer (RCB) (*Pennisetia marginata*) larvae severely damages crowns and roots of raspberry plants. The larvae are capable of chewing tunnels into the woody tissue. By living inside the plant it makes the larvae invulnerable to many pesticides.

RCB requires two years to complete its life cycle. The adult moths (pictured below) appear in mid-summer and can be seen during the day resting on the leaves of the plants. Eggs are individually placed on the undersides of leaves. Upon hatching, the tiny white caterpillars migrate to the base of the canes. Here, they either excavate a small blister like cavity under the bark near the base of the stem or find a protected place under loose bark to overwinter. In the spring, the larva resumes activity and usually tunnels into a new cane and girdles it before returning to the crown and root tissue. The second winter is spent in the upper root. By the second summer, the crown area can be extensively tunneled and severely damaged. A plant’s entire crown may be damaged.



Raspberry crown borer (*Pennisetia marginata*). Adult raspberry crown borers mimic yellowjacket wasp coloration for protection.



Rose stem girdler (*Agrilus cuprescens*)

Control

Removal and destruction of infested plants before the new adults can emerge and reproduce is recommended. Drench applications of insect parasitic nematodes of the genus *Steinernema* around the base of the plants before the larvae can chew their way into the plant crowns can help reduce the population of RCB and several other root feeding pests. These nematodes are available from various vendors of biological control organisms and organic pesticides.

Timing is critical for topical pesticide applications to control RCB. Caterpillars are only vulnerable to pesticide applications for a limited time. Sprays must be applied to the first stage RCB caterpillars before they move down to the crowns and chew their way into the plants.

Flat-headed cane borers

The **rose stem girdler** (*Agrilus cuprescens*) (pictured below), **bronze cane borer** (*Agrilus rubicola*), and the red-necked **cane borer** (*Agrilus ruficollis*), are three species of metallic wood boring beetles that attack raspberry plants and primarily damage canes above ground by tunneling under their bark. In Wyoming, the rose stem girdler and bronze cane borer are more common. However, if red-necked cane borers are accidentally introduced by planting infested raspberry plants they could potentially establish. Wild raspberries can harbor these pests. Due to our lack

of wild raspberry plants adjacent to farmlands, currently, Wyoming growers can have cane fruit fields isolated from these pests. It is very important that new pests are not accidentally introduced onto your farm when importing plant material.

The adult beetles of the rose stem girdler and bronze cane borer are slender and have an iridescent bronze to copper sheen and are between 1/3 and 1/4 inch in body length. The red-necked cane borer beetle is also small and has a reddish-colored collar that contrasts sharply with its black head and wing covers. The life cycle of the three species are nearly identical. Adult cane borers are present from May to early August. They feed along the edges of the leaves and can be observed crawling on the raspberry leaves during the day. Female beetles deposit whitish, scale-like eggs along the bark of the new canes starting in late May to early June. The larvae hatch from the eggs and chew their way under the cane’s bark. The bronze cane borer and the red-necked cane borer do not girdle the cane as the raspberry cane borer and the rose stem girdler do, but later the tunneling of the larva causes a symmetrical swelling to form on the infested cane. In early August, the larvae tunnel into the cane’s pith. The larvae are full-grown by fall and remain in the tunnel during the winter and pupates in the spring. New adults of all of these pests emerge beginning in May, weather dependent.

The approximate calendar dates important for control of serious pests of cane fruit plants.

LIFE CYCLES OF COMMON CANE FRUIT BORER PESTS							Fall & Winter Months
	April	May	June	July	Aug.	Sept.	
Raspberry Crown Borer (2-year life cycle)							
Year 1		2 year old larvae pupate		Adult moth mating with egg production and hatch			Larvae overwinter on cane bases
Year 2		Larvae resume feeding and bore into canes causing swellings on canes at the crown					Larvae spend second winter in the cane crowns
Bronze Cane Borer (annual life cycle)	Larvae ends diapause and pupates	Adult beetle leaf feeding and egg production					Larvae overwinter in the pith crown
			New larvae tunnel under cane bark causing visible damage by late July				

Control

Remove all canes that show swelling from the borer larvae feeding and destroy them. Insecticides directed at adult beetles can be applied on the plants pre-bloom to just before blossoms open to protect pollinators. The length of the insecticide residual control product chosen should try to cover the period of active feeding by the adult beetles to save on cost and labor.

Rose stem sawfly

The rose stem sawfly (*Hartigia trimaculata*) (pictured following page) is a plant feeding member of the order Hymenoptera that can be found in Wyoming and is widespread because it also attacks wild and domestic roses in addition to cane fruit plants. The larvae of this insect bores into the canes and eventually girdles them causing the plant tissue beyond the feeding site to wilt and die. This pest produces two generation per year so plant damage can rapidly escalate.

Control

Cultural control by pruning out the canes infested by the first generation is the primary method to minimize the damage caused by this pest. The infested canes need to be cut back to just below where the larvae began tunneling in the pith to ensure the insect is removed. The pruned out infested canes need to be destroyed to kill the larvae. Foliar pesticide applications for controlling the adult populations of this pest haven't been shown to be very effective.

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Rose stem sawfly (*Hartigia trimaculata*)

Root weevil species

Another subfamily of insect that is widespread in Wyoming and can damage cane fruits and many other tree and shrub species are the broad-nosed weevils (pictured below) from the subfamily *Entiminae*. The larvae of all of these invasive species in the genus *Otiorhynchus* are collectively referred to as root weevils. The larvae feed on the outside of the roots and can severely stunt the growth of plants. New transplants are especially vulnerable to the root damage. Three species, the common names of which are black vine weevil, strawberry root weevil and rough strawberry root weevil, are known to attack many fruit-bearing plants. The characteristic small square notches in leaf edges done by nocturnal feeding adult weevils is often the first thing that reveals their presence. The best way to diagnose them as the cause of failing plants is to dig them up and examine the roots in late summer. Examination of the soil close to the roots of infested plants can reveal the legless white root weevil larvae and their feeding damage.

Control

The adult root weevil beetles are leaf feeders when they emerge from the soil in the spring. Foliage applied pesticides such as the fungal pathogen *Beauveria bassiana*, biopesticides containing active ingredients such as spinosad, azadirachtin and many synthetic pesticides can be applied to plants before they start blooming to kill the adult root weevils feeding before they start producing eggs. Each root weevil can produce hundreds of eggs, they are all female and reproduce via parthenogenesis. A very high level of adult root weevil mortality is needed to suppress the larvae population and reduce root damage.



Tomasz Klejdysz, shutterstock.com

Broad-nosed weevil (*Otiorhynchus*)

In addition to the adult root weevil control efforts, entomopathogenic nematodes can be applied in drenches to the soil around the plant crowns to kill the root weevil larvae. *Heterorhabditis bacteriophora* nematodes can be effective if soil moisture and temperature are suitable for them. *Steinernema carpocapsae* and *S. kraussei* are two other species of insect parasitic nematodes that will work in cold climate soils. The insect fungal pathogen *Metarhizium anisopliae* is available in a pesticide labeled for drench application against root weevil larvae in the soil. It can also be applied to the foliage for adult root weevil suppression. However, due to *M. anisopliae* spore's deactivation under UV light exposure, its residual control on leaves is very short in high-altitude sunlight.

OCCASIONAL FOLIAGE PESTS

Roseslug sawfly

Roseslug sawfly (*Endelomyia aethiops*) adults are small, less than a ¼ inch long, dark colored, non-stinging wasps whose larvae (pictured following page) skeletonize rose and raspberry leaves by eating the upper leaf surface and interior cells, leaving the bottom of the leaf intact. Before pupating the larva will be close to ½ inch long. In a dry climate the surface of the leaves left uneaten eventually dry out and flakes away. The larvae look similar to caterpillars but can be distinguished as sawflies by having more than four sets of prolegs on the abdomen behind the three pairs of what will be thoracic legs, just behind the head.



A close up of a roseslug sawfly larva (*Endelomyia aethiops*) eating down to the lower leaf surface and leaving behind the veins. They are frequently pale green in color and you can see into their body faintly.

Control

The weak sawfly larvae can be physically hosed off plant leaves with water. Once on the ground they can't climb back on the plant. Horticultural oil and insecticidal soap solutions are low-toxicity, biorational insecticides which are labeled for use on foliage feeding pests like these sawflies. Currently available *Bacillus thuringiensis* (Bt) products such as Bt *kurstaki* and Bt *aizawai* are NOT effective on larval sawflies. If the defoliation is very bad (potentially >50%) broad spectrum insecticides can be used but label precautions need to be followed to protect insect pollinators if the plants are blooming.

Two-spotted spider mites

Two-spotted spider mites (TSSM) (*Tetranychus urticae*) (pictured below) are so small you often notice the leaf discoloration caused by them sucking the plant cell contents out, and the silk webbing they put on the leaf surface before you actually see the mite themselves. TSSM feed on many different crop plants and are usually present in low numbers in all fields. When pesticides, such as carbaryl products for example, are used to control other plant pest species, the insecticide may not kill TSSM. However, it can unintentionally devastate TSSM's insect predators such as minute pirate bugs. The population of TSSM can then expand unchecked and cause significant injury. This is another reason to monitor the results of all pesticide applications. This can also happen when crops are grown in high tunnels as the TSSM's primary predators may be unintentionally excluded.



Two-spotted spider mites (TSSM) (*Tetranychus urticae*) are less than 0.5 mm long as adults but attack a huge number of crop plant species.

Insuring crop plants are not water stressed can help them cope with TSSM feeding damage. If feasible with your production system overhead watering of the plants can physically dislodge TSSM. Minimizing dust from adjacent field and roads also reduces TSSM populations. There are mite specific pesticides with ingredients such as bifenazate, acequinocyl, and etoxazole currently labeled for cane fruits. These mite specific active ingredients have reduced impact on the insect predators of TSSM. Field releases of beneficial predatory mite species, reared commercially, can also work to suppress TSSM populations. The predatory organisms work best for suppressing TSSM populations that have not yet reached economic thresholds.

PESTS THAT ATTACK THE FRUIT

Spotted wing drosophila

The spotted wing drosophila (SWD) (*Drosophila suzukii*) (pictured following page) is a relatively new invasive pest in Wyoming. It is different from other endemic fruit fly (*Drosophilidae*) species in that the female can insert her eggs into ripening undamaged fruit with a serrated



Hannah Burrack, North Carolina State University, Bugwood.org

A pest monitoring trap like this one designed for spotted wing drosophila can help you determine when to initiate management actions to optimize results.

ovipositor. The rapidly developing larvae quickly make the infested fruit worthless. Unfortunately, cane berries are favored hosts of this pest. If your farm doesn't have SWD already try to keep it that away by not allowing plant material, like fruit, from SWD endemic regions that might harbor this pest onto your property.

Control

If you have SWD, then trapping with sticky yellow cards (pictured below) or species specific traps should be used to monitor their population levels through the growing season. The trap data can help you decide when to treat SWD and determine the efficacy of the treatment. Maintaining an open canopy in your berry patch via pruning can make environmental conditions less favorable for SWD. SWD prefer shady and humid conditions created by thickly growing plants. An open plant canopy also makes it easier to get good coverage during pesticide applications. Removal and destruction of infested fruit plus the rapid harvest and cold storage of good fruit is recommended. Applications of labeled pesticides to suppress SWD populations should only be used during the times in the field when pollinators are not active on flowers. You must follow the pre-harvest and field re-entry intervals listed on pesticide label after applications. Alternate the pesticide



Hannah Burrack, North Carolina State University, Bugwood.org

Spotted wing drosophila (*Drosophila suzukii*)



Commercial or homemade traps placed in the early spring around fruit production fields can capture the new queens while they forage for their first cohort of daughters. This can reduce the numbers of worker wasps raiding fruit later in the summer.



A yellowjacket flying up to a raspberry already being fed upon by two European paper wasps.

the possibility of resistance occurring in SWD populations. For organic growers this can be difficult as pyrethrum and spinosyn are the only two active ingredients that have formulation that qualify as organic. Already reports of poor control of SWD with pyrethrum products are being made by fruit growers in Michigan. Reliance on multiple applications of broad-spectrum insecticides, whether organic or synthetic may cause a two-spotted spider mites or other pest populations to explode. The predators of the spider mites that usually keep them in check are vulnerable to the same broad-spectrum insecticides currently labeled for SWD.

Yellowjackets and European paper wasps

Yellowjacket wasps and the new, invasive European paper wasp will attack ripening berries and other fruits as a source of carbohydrates in the summer. The damaged fruit becomes unsaleable and the stinging wasp activity makes harvesting the ripe fruit hazardous. Commercial traps baited with heptyl butrate are effective for catching *Vespula* species yellowjackets but ineffective for European paper wasp (*Polistes dominula*)

The European paper wasp is attracted to fermenting fruit. Use drowning traps and a bait recipe of 2 fluid ounces of cheap fruit juice, 20 fluid ounces of water, ¼ teaspoon active dry yeast, and ¼ teaspoon dish soap. Two-liter plastic bottles with their tops cut off and inverted are baited with the solution and hung up around the perimeter of the fruit production area. The number of traps needed varies with pest pressure and location.

Grasshoppers

Several species of crop pest grasshoppers will feed on the leaves of cane berries and much worse, from an economic damage standpoint, the fruit itself. Treating grasshoppers early in the habitats they originate from is the best type of management strategy. The ideal goal is to prevent grasshoppers from migrating into your berry patch. Many control options for grasshoppers exist for non-crop habitats and are usually much less expensive than pesticide products labeled for use on cane fruit crops.

Control

Adult grasshoppers are very mobile and will travel a long way to find food when they are starving. If grasshopper swarms invade your fields when cane fruit is ripening, they will feed on it. In the period just before fruit harvest it is difficult to manage adult grasshoppers. Insecticide products labeled with a short pre-harvest interval may not provide good control of adult grasshoppers. Another confounding problem with insecticide treatment is that grasshoppers are cannibalistic and are attracted to the odor emitted from decaying bodies. This could attract even more grasshoppers into the crop.

Some horticultural products are advertised as having grasshopper repellent and/or anti-feeding properties. Products making these claims may contain ingredients such as garlic extracts, capsaicin, denatonium benzoate, and soaps that could impart an off taste or odor to plants and fruits treated. An odor-free pest deterring product with low to no toxicity and high repellency to grasshopper would be ideal. You don't need to kill them if the grasshoppers aren't eating your plants and fruit. In a small-scale field trial conducted on non-fruiting shrubs, azadirachtin, which is extracted from neem tree leaves, was the only effective short-term grasshopper repellent of the limited number of products tested. Until more effective and properly labeled grasshopper repellent products are developed, using row covers to exclude grasshoppers from ripening berry crop is the only sure way to protect the fruit.

BIRDS AND OTHER GRAZERS

Birds, deer, moose and other wildlife may visit your raspberry planting in search of the ripening fruit. Fencing can prevent larger mammals from gaining access. When fruit is ripening, shade cloth or bird netting can keep the birds out if they become a problem.



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