Flex-Ro has been working within test plots and has succeeded at planting corn and soybeans while moving at a pace of around 2 mph.

Robot Handles Planting, Crop Monitoring

University of Nebraska-Lincoln scientists and engineers have teamed up to build an automated planting and crop monitoring system. The flexible robot, known as Flex-Ro, is a 60-hp. high-clearance field platform with 4-wheel steering and 4-WD. It's gas-powered and can be operated with a wireless remote or in an autonomous mode by providing GPS points.

"Flex-Ro is a research project that began as part of my agricultural robotic research program in 2016," says Santosh Pitla, Ph.D., associate professor of advanced machinery systems. "Our goal back then was to create a multi-purpose autonomous robotic platform to perform different field operations. Fast forward to 2023, and we realized our vision. Today, Flex-Ro can do multiple types of field operations."

Flex-Ro has been working within test plots at the no-till Rogers Memorial Farm. It has succeeded at planting corn and soybeans while moving at a pace of around 2 mph. It has obstacle-detection and avoidance capabilities as well.

Beyond planting, the robot can collect data from onboard sensors to monitor plant height, temperature, humidity, and more. It has a camera, spectrometer, temperature and humidity sensors, and ultrasonic sensors. It's capable of navigating on its own when programmed with GPS coordinates. This is considered "supervised autonomy" as it requires human input for setting its route and monitoring the planting process.

Flex-Ro's modular design means the robot serves multiple purposes with a quick change in equipment. Eventually, the team hopes to use it for seeding cover crops using a bulk seed hopper. One 5-year goal is to use Flex-Ro robots and drones to plant, spray, and apply fertilizer across the whole 300 acres of the Memorial Farm.

"Our long-term goal is to create more Flex-Ros with hybrid drive trains and operate them in a swarm configuration (a team of robots)," says Pitla. "Soon, we'll be exploring targeted spraying and nitrogen management application as well."

Regarding commercial viability, Pitla believes more research is necessary to prove the robot's value. "A University-based start-up company will assess the feasibility of Flex-Ro commercially."

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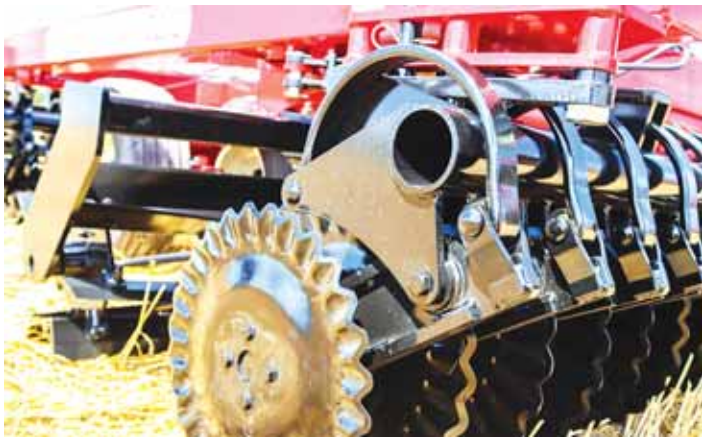

CanTILLeaf springs maintain a constant down force on disks, so they travel straight to evenly cut trash.

Unique Spring System Handles Many Soil Conditions

A new independent CanTILLeaf spring system on the McFarlane Incite-i5200 tillage tool allows the machine to work in more difficult soil conditions than a conventional disk or vertical tillage tool. With 5 1/2-in. clearance to release over rocks and a cleaning system that clears away sticky soils, the CanTILLeaf maintains a constant down force on disks, so they travel straight to evenly cut trash.

Steve Schlumbohm uses a 5124 model Incite and says the machine works well at any depth because the CanTILLeaf springs hold disks firmly at any depth from shallow to 6 in. deep. The Incite can cut and blend residue in the fall, incorporate cover crop seed lightly into the soil, and also works well preparing spring seed beds for planting. Schlumbohm says the Incite is built well to handle deep tillage and that the CanTILLeaf springs hold the disks in place traveling at speeds up to 8 mph.

Illinois crop farmer Don Thiems uses his Incite mainly on corn stalks to size residue and pin it to the soil, which helps prevent erosion. Thiems says the disks are held firmly in the ground with the CanTILLeaf springs, and if rocks are encountered, disks can lift and immediately go back in the ground. Another advantage Thiems notes is that disks can be pitched from 3 to 9 degrees, so more soil can be thrown to cover heavier residue without causing ridges in the field.

CanTILLeaf springs have bronze bushings for long-term operation without greasing. The maintenance-free hub is greased for life. The high-strength steel spring is designed to withstand tough working conditions without breaking.

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Roessler decided to make his own stump grinder after renting, using a Grasshopper with the front pto in mind.

Zero-Turn Stump Grinder

Grasshopper zero-turn mowers are known for their wide range of implements, but only Larry Roessler has a stump grinder on his.

"It's really dirty with chips flying, but it's so nimble," says Roessler. "I can grind up a stump and then follow roots, zigging and zagging as they do."

Roessler got the idea to build a stump grinder after renting one for $300. He had jammed his lawn mower into a stump on a new property. He built it with the Grasshopper's front pto in mind. He bought a gearbox, bearings, hubs, and a keyed shaft and coupler from Surplus Center. He fabricated much of the rest with the help of carbide bits from CEI Supply.

"I went through plenty of bits," he says.

The gearbox is mounted rigidly to the mower frame. The cutting wheel rides on a spring-supported frame mounted to pillow block bearings on the gearbox output shaft. The frame is made mostly from 1 1/4-in. steel tubing and pivots on the mower's toolbar.

The lift springs are from an old farm implement with one end 3 1/2 in. from the pivot point. The other end of the twin springs is connected to a post on the mower frame. A threaded rod between the post and the springs lets Roessler adjust the tension so the cutting wheel will float. A third light-duty spring, between the cutting wheel end of the frame and a lever on the mower, lets him fine-tune suspension.

A belted pulley between the gearbox and a pillow block bearing on the output shaft of the gearbox drives the cutting wheel.

"I had to fabricate an extension to the gearbox shaft to provide space for the pulley and the bearing," says Roessler.

The cutting wheel is two pieces of 4 by 12-in., 5/8-in. steel plate. They're welded in a cross shape with a piece of 1/2-in. plate in between to offset the grinding bits or teeth. The 1/2-in. sq. bits are mounted in split hubs at the ends of the cross plates. A third piece of 5/8-in. steel is added to the cross plates to provide extra width for the split hubs.

"The heavy welding caused the plates to warp, and I had to press them straight again," says Roessler. "In hindsight, I should've bolted the stack together and then put several small welds to hold everything in place."

The cutting wheel rides on a shaft suspended from the front ends of the frame with a 3 1/2-in. pulley for the belt drive. The pillow block bearings they ride in can be adjusted to take up belt slack. The ends of the shaft have bolts with heavy washers to prevent the belt from walking.

"Initially, I attached a linear actuator between the mower frame and the cutting wheel with a toggle switch to lower the wheel into the stump," says Roessler. "However, the load on the wheel would be erratic, and it would either jam or run with only a light load. Instead of it, I simply apply pressure with my feet. The footrest can flip forward or backward to shorten or lengthen leg travel."

Grinding stumps is rough on the pto shaft spline, acknowledges Roessler. "After replacing two mower shaft splines, I incorporated a 1-in. keyed shaft for the mower pto. The gearbox now mounts to the pto shaft with a keyed coupler, and I've had no more problems."

The cutting wheel operates at the same rpm's as the Grasshopper's 14-hp. motor, upgraded with a bigger carburetor to 16 hp. Roessler installed a metal shield over the cutting wheel and a piece of rubber tire underneath the frame to deflect some of the chips. Enough fly back at him that he always wears a face shield.

With only $60 more than his previous rental rate invested, Roessler is more than satisfied with how his stump grinder works.

"We had a major windstorm come through earlier this year, and it blew over trees," says Roessler. "I had relatives coming out of the woodwork needing stumps ground out. I don't charge. Mostly, I do it for the free meals."

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"I incorporated a 1-in. keyed shaft for the mower pot. The gearbox mounts to the pto shaft with a keyed coupler."