empowering 16(ws)0.1(m t(6 p)12()13()-5(c)-7()-4.9(6.9()8(4.1()7(S)3(9(n)3(5noe crop fertilizer applications [9].

O d

Precision nutrition addresses the inherent variability in soil composition and plant health by leveraging advanced technologies to precisely deliver nutrients where they are needed. e use of sensors allows farmers to gather real-time data on soil conditions, enabling informed decisions on fertilizer composition and dosage. By tailoring nutrient delivery to the speci c requirements of each crop, farmers can optimize growth conditions and enhance overall productivity.

T c ca a

e integration of sensor technologies, satellite imaging, and automated machinery has been instrumental in the progress of precision nutrition. Sensors provide granular insights into soil health, enabling farmers to make on-the-spot adjustments to fertilizer applications. Satellite imaging o ers a macroscopic view of entire elds, facilitating the identi cation of spatial variations in soil fertility. Automated machinery equipped with precision application systems ensures accurate and e cient nutrient distribution, reduci-8()nows tieva n-tanual labor [7].

S (a a) a)(b))- a)-)-(c)-)-))) a ac a c b c c c a a d a c c a ac c

C a d ad ba

While precision nutrition holds immense potential, challenes reSain. Initial costsssociated with acquiring and implementing adv-80.1(a)d technologies can be a barrier for somrmers, especially 16(ws)05ose in resource-constrained settinddditionally, 16(ws)05eed for 166()-5(6(nic)-2.9()-5(exp)-9(r)-10()-4.9()3()8(a)9(n)4(d d)-3()19()-6(in)19(6(r)-10()12.1()3(t)6()19()5()12(p)96s)8(s a le)6()9()6(in)8(c)-7(ur)-29()8()( )T0.26 education, and 16(ws)05velopment of user-friendly 166()-4.9(6(n)4(6)7(og)-5(es [8].

e integration of big data analytics allows5farmers to make sense of the vast amount of information collected from senors and other sources. is analytical approach enhancesws redictive capabilitiesf farmers,

F c

As 166()-5(6.1(n)4(6)7(og)-24(co)12(n)19()-5(n)19(ues t(6 e)-8()8()7()7()8()6(16(ws)05 looks promising. Continued adv-80.1(a)ments in arti cial inte vlige1(a)1, Sachine learning, and robotics are expected to further enha1(a)1 16(ws)05e precision and e ciency of fertilizer application. e increasing availability of a ordable technology and 16(ws)05semination of knowledoe will likely contribute to wider adoption, bridoing 16(ws)05p between precision ariculture and 166()(adi)12()-5(o)12(n)3(a)-4.9(fa)9()-6(min)8(p)12.1(

Precision-nutrition represents a sioni cant leap forward in the quest for sustainable and e cient ariculture. e integration of 166()-5(6(n)4(6)7(og)-23.9(a)9(n)4(d d)-3()19()-6(-dr)-6()7()8.1(1 a)19()11()12()13()-5(reduced environmental impact. As adv-88.9(n)4(em)4.1(n)19(s co)12(n)19()-5(n)19(production.

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